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The Refrigeration Service Engineer

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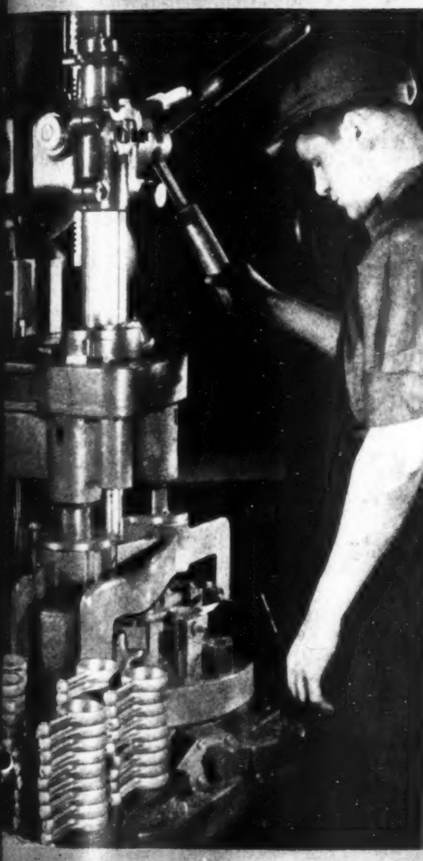

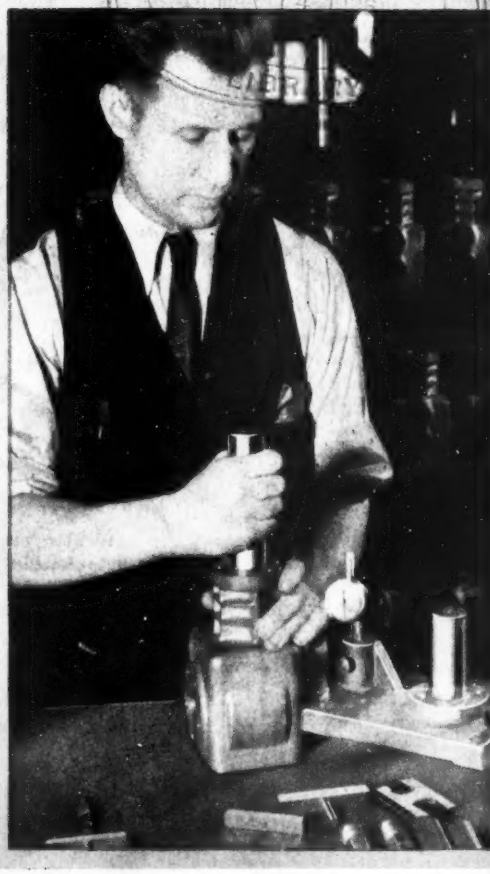

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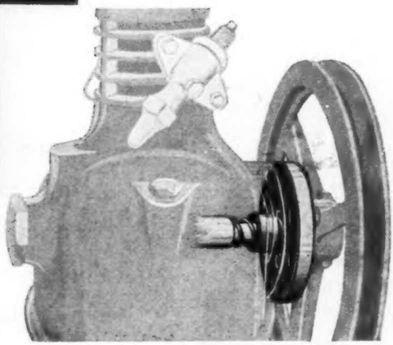

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VOL. 4 MARCH, 1936 NO. 3

COVER

This month's cover illustrates two operations in the building of domestic refrigerators by a large manufacturer. These pictures show construction of Crosley units, the left photo illustrating the drilling of both holds on the connecting rod preparatory to diamond boring, while in the right, an inspection of the finished crankcase is being made.

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Lubrication of Methyl Chloride Compressors

A General Discussion Covering Selection and Proper Use of Lubricants in Mechanical Refrigeration Systems.

By E. W. McGOVERN*

EACH refrigerant presents lubrication problems which are more or less different from those of other refrigerants, although the hydrocarbons and halo-hydrocarbons, methyl chloride included, may be grouped into a class having generally similar lubrication characteristics. Refrigerants in this class are characterized by their complete miscibility with and chemical inertness toward ordinary petroleum lubricants. Therefore, while we will confine our discussion here to lubrication of methyl chloride equipment, a large part of the data applies to other soluble refrigerants also.

Solubility of Methyl Chloride in Mineral Oils

Practically all of the special considerations in lubricating methyl chloride refrigeration systems depend on the solubility relationships of methyl chloride with the lubricants used almost exclusively—mineral oils. Liquid methyl chloride and the oils usually encountered are mutually soluble in all proportions, but the amount of methyl chloride vapor that will dissolve in an oil depends upon temperature and pressure. The pressure-temperature-composition chart, Figure 1, presents solubility data for all commonly encountered conditions. It will be noted that the higher the pressure and the lower the temperature, the greater the amount of methyl chloride that is absorbed. The solubility of methyl chloride gas does not change very rapidly with pressure when it has a fair amount of superheat, but as saturation conditions for the pure substances are approached, the amount absorbed increases very rapidly until finally only the amount of methyl chloride available limits the extent of oil dilution.

The solubility chart was constructed from data for a highly refined white oil of 320 seconds viscosity but can be considered as giving a fairly accurate representation of solubilities with any of the oils used with methyl chloride. Determinations made with a similar oil but of only 150 seconds viscosity over a composition range of 7% to 18% methyl chloride indicated that its solubility relationships did not differ from those of the 320 second oil within the limits of experimental error. In early refrigeration practice certain oils described as of the

* Engineer, R. & H. Chemicals Co.

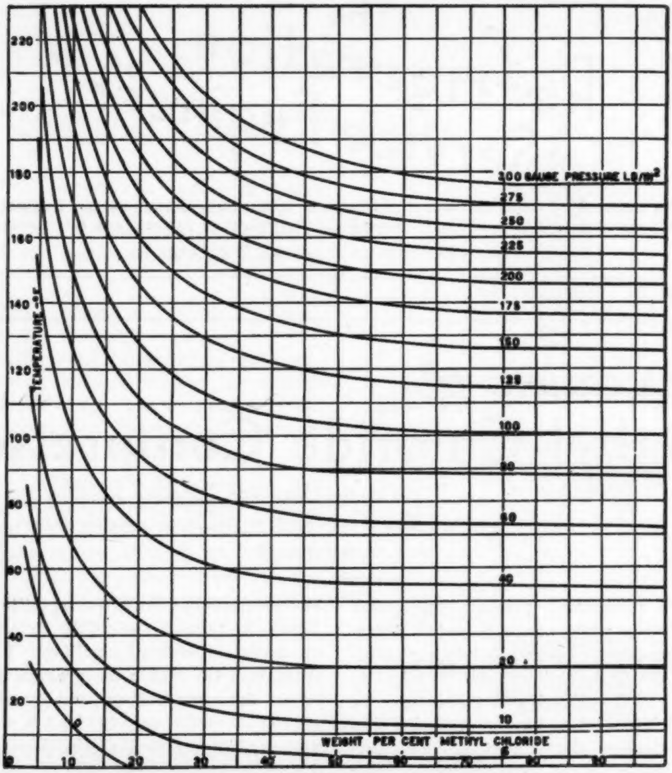

FIG. 1. TEMPERATURE-PRESSURE-COMPOSITION RELATIONSHIP IN THE SYSTEM— —METHYL CHLORIDE AND S/V INDUSTRIAL WHITE OIL

Courtesy Refrigerating Engineering.

"residual" type were of limited but still high solubility in methyl chloride but these do not appear to be used at present.

Dilution and Lubricating Value

It was at first thought that dilution of oil by methyl chloride would seriously detract from its lubricating value, but experience has proved that this is not the case and that in some respects the condition proves actually beneficial. One firm producing well-designed methyl chloride compressors has observed the original fine machine marks on wearing surfaces after eight years' operation with an oil of the highly refined type. Certain machine parts are especially subject to wear when used with non-soluble refrigerants because of the difficulty of getting oil to them by ordinary means while, in the case of the soluble refrigerants, foaming and entrainment provide for sufficient lubrication of these parts.

Viscosity

While viscosity is not in itself a measure of lubricating value, it is a contributing factor and is especially important in comparing the relative lubricating values of lubricants of the same type but of different viscosities. The viscosity chart, Figure 2, indicates how temperature variations and dilution with different amounts of methyl chloride affect the viscosity of an oil. It will be noted that the viscosity lowering produced by dilution

encountered under ordinary conditions is comparable in magnitude to that produced by heating to operating temperatures, and, therefore, is easily taken care of by the now general practice of using oils of somewhat higher viscosity than are used with "non-soluble" refrigerants.

Oils of from 150-320 seconds viscosity are generally used in the various types of methyl chloride equipment although in special instances oils with viscosities above and below this range have been considered advisable and used with satisfaction. Bearing pressures and operating temperatures, these depending upon size, type and location of machines, are important in deciding on the viscosity of the oil to be used. A compressor operating at higher crankcase temperatures will have a lower concentration of refrigerant dissolved in the oil and, therefore, from the standpoint of lubrication, does not require an oil of as high viscosity as when crankcase temperatures run lower. If the crankcase oil solution is of too high viscosity, power consumption is unnecessarily high. Excessively high viscosity oils may also involve difficulty in oil return, especially in certain types of flooded systems, and crankcase foaming may be increased.

Oil Foaming

When crankcase oil is exposed to refrigerant gas under the fluctuating pressures encountered on the low side of a system, there are different amounts of refrigerant dissolved in the oil depending on its temperature and the pressure of the gas above it. As a machine cycles and the low side pressures rise and fall, the refrigerant alternately dissolves in the oil as the pressure is rising and is boiled out of the oil as the pressure drops. Changes in temperature of the oil, of course, also have an important effect on oil-refrigerant concentrations and this is especially important when a compressor has been idle for some time in a cold location.

Rapid evolution of refrigerant gas from the oil, resulting when pressure drops quite rapidly, generally causes the oil to foam. Foaming is encountered to a greater or lesser extent with all refrigerants, as none is completely insoluble in oil, but the condition is of course intensified with refrigerants of higher solubility. As noted above, foaming is beneficial in ensuring adequate lubrication of parts otherwise reached with difficulty but, unless it is properly controlled or eliminated, it may produce one or more of the following undesirable conditions:

1. Slugged oil may produce a compressor knock.
2. Excessive foaming may produce a dry crankcase so that there is insufficient lubrication until the oil is returned after circulation through the system. This, and to a lesser extent the knocking condition, are generally extreme cases that may be encountered in starting up a cold machine.
3. Excessive oil carry-over may produce an oil-logged evaporator in flooded systems because of oil being carried to the evaporator faster than it is removed.

Violent agitation of crankcase oil in splash-lubricated systems contributes to the above factors by its tendency to throw oil where it can be carried along with the suction gas as well as by aiding the solution and dissolution of gas.

The undesirable consequences of oil foaming are avoided by design features which often vary considerably with different manufacturers. Of course, those methods which are designed to narrow oil-refrigerant concentration changes also narrow viscosity changes. Narrowing the range of crankcase pressures by shortening the operating cycles diminishes the amount of concentration change and, therefore, lessens foaming. Concentration changes may also be lessened or eliminated by control of crankcase pressure toward constancy. Also, control to give a gradual rather than sudden decrease of crankcase pressure allows the gas to escape slowly and gives the gas bubbles a chance to break before being drawn into the compression chamber. Some oils, especially those of lower viscosity, have been reported as not foaming as much as others. Oil level should not be too high in the crankcase.

A very cold machine may have a very dilute oil in the crankcase and the attendant troubles may be encountered at their worst in starting such a machine. Preliminary heating of the crankcase oil may be desir-

able and some machines have been equipped with built-in electrical heaters for this purpose.

Drawing the suction gas directly into the cylinders from the evaporator, avoiding the crankcase if there is one, eliminates or alleviates concentration changes to a degree depending upon the compressor type and details of the system. Those types in which the oil reservoir is not subjected to pressure changes have no foaming problem although there may still be excessive oil pumping due to mechanical causes. In these machines, only temperature affects amount of dissolved methyl chloride and, therefore, alters viscosity indirectly as well as directly. A moderately warm oil containing a small amount of dissolved refrigerant is preferable to a cold oil containing a high concentration of refrigerant and, therefore, special provision may be made to keep the oil warm if the usual heating in the cylinders does not suffice. One manufacturer accomplishes this by heat interchanging with the high pressure superheated gas.

Return of Oil from High Side

Even with slugging and foaming eliminated, high pressure exit gas always carries oil in an atomized or nebulous form. While the most common practice is to allow this oil to circulate through the system a number of traps have been devised, some of them very efficient, to separate the oil particles from the gas, the trapped oil being returned to the oil reservoir by a float-operated valve. Such oil traps are essential on certain types of refrigeration systems, notably those with such flooded evaporators as do not provide sufficiently for oil return. If an oil trap is not used, or if the trap is not 100% efficient, oil particles dissolve in the condensing refrigerant and the resulting solution is fed from the liquid receiver into the evaporator. As no oil separates in the liquid receiver, a difficult problem is avoided at this point.

Dry Expansion Evaporators

In "dry expansion" systems evaporation of refrigerant leaves oil particles suspended in and carried along by the high velocity gas stream through and from the evaporator to the low side of the compressor where the returned oil may add to that in the oil reservoir or may again go through the compressor, providing some lubrication as it goes. Gas velocities of 1,000 to 2,000 feet per minute are considered ample to keep the evaporator well clear of oil. As a general rule with "dry expansion" evaporators, equivalent to not more than 200 feet of 3/8" to 1/2" tubing, there need be no oil added to the system above the normal compressor charge. However, above this, about a pint of oil per 200 feet additional coil may be added to allow for that in circulation. These figures may vary according to gas velocities and amount of oil in suspension so that the allowance may run one quart of oil per 100 feet of 5/8" tubing.

Flooded Evaporators

Return of oil from a flooded evaporator is not as simple as return from a dry expansion evaporator and the treatment of the problem for soluble refrigerants is of course generally different from that for the insoluble. As methyl chloride oil solution is carried into a simple flooded evaporator and the refrigerant vaporizes, there is a tendency for the oil to accumulate. However, just as the oil-refrigerant solution in the crankcase tends to foam as the refrigerant gas is expelled, a somewhat similar condition is encountered in a flooded evaporator. Evaporation of methyl chloride from the bubble films rising from the surface of the evaporator liquid leaves oil-rich films which finally break throwing a blanket of fine oil particles above the surface of the evaporator liquid. The tendency of these particles to settle back into the refrigerant liquid is opposed by the movement of the gas stream toward the suction line. The latter must be designed and placed so that excessive amounts of the oil particles do not drop back and that large slugs of refrigerant liquid are not carried by the suction line so as to cause "frosting back." A number of designs have been used to allow evaporation of refrigerant from liquid splashed into the entrance to the suction line before it leaves the evaporator chamber.

A flooded evaporator like that described above is satisfactory unless oil pumping is excessive or unless there is superheating of the oil-refrigerant solution with the result

that oil is carried into the evaporator faster than it is carried out. Operation is considered normal when the system stabilizes, that is the oil intake and output are equal, at 15 to 20% by weight oil in the evaporator solution. Solutions of this concentration will boil very close to the saturation temperature for pure methyl chloride unless the evaporator design is such that the solution is allowed to superheat above its normal boiling point. The following figures (1) show the approximate rise in boiling point at atmospheric pressure for various concentrations of oil:

Oil—% by Volume	Boiling Point Rise—°F.
0%	0.0° F.
5	0.0
10	0.9
20	0.9
50	5.4

According to the composition chart, Fig. 1, the boiling point rise, except at very high pressures, is even less than the above figures would indicate.

In order to provide for unusual conditions occasioned by temporary excessive oil pumping, inefficiency of the oil trap or superheating of the liquid refrigerant, a supplementary and more positive form of oil return is generally desirable. Various wick devices leading from the refrigerant-oil solution to the suction line are being used successfully.

Desirable Characteristics of Oils

Special refining of oils to prevent reaction with methyl chloride is unnecessary as methyl chloride is chemically inert toward mineral oils. This statement is by no means meant to suggest that low-grade oils can be used as other factors enter which require that high-grade oils be used with all refrigerants. A distinction is made between methyl chloride and refrigerants that require oils specially refined to lessen, or, if possible, eliminate their tendency to react with the refrigerant.

Quite a few oils that have given good results as lubricants in methyl chloride machines conform to the following tests:

Viscosity .... 150-330 seconds Saybolt at 100° F.
Moisture Content ...... Less than 0.01% by weight
Pour Point...... —10° F. or below
Acidity .... Neutral—acid equivalent to not more than 0.01 mg. KOH per gm. oil
Flash Point..... 320°-400° F.
Saponifiable Matter .... None
Sulfur Content.. Less than 0.15%
Sligh Oxidation Number ...... Less than 10

Experience may show that certain oils which do not conform to all of the above tests are entirely satisfactory. In fact, as a general rule, no oil should be used which has not been carefully tested and found satisfactory in equipment of the type in which its use is proposed. Servicemen should use only those oils recommended by the maker of the machine being serviced. At any rate, while the above tests need not be regarded as inflexible specifications, they are all based, some to a greater extent than others, on research and experience. Viscosity has already been discussed and reasons for limitations on other tests are given below.

Moisture Content

Moisture is undesirable in a methyl chloride system because any water above a very small quantity may freeze out and block refrigerant lines and orifices in cold parts of the system. Also, continued operation in the presence of moisture especially at higher temperatures may result in the formation of corrosive hydrochloric acid, although none is formed at ordinary temperatures. As it has been found advisable to manufacture methyl chloride to a specification of 0.01% by weight maximum moisture content, it is reasonable to expect the same dryness of the oil used with it. Oils are generally sold on a specification of dielectric strength rather than percentage moisture content, and an oil of approximately 30,000 volts dielectric strength may be considered as being satisfactorily dry. Figure 3 shows how dielectric strength of an oil may vary with (4) moisture content. To keep the oil dry, exposure

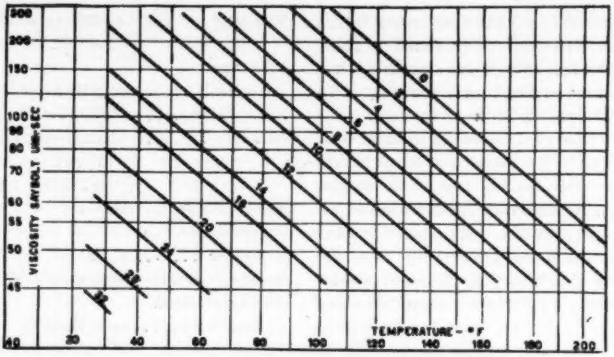

FIG. 2. VISCOSITY TEMPERATURE CHART—MIXTURES OF METHYL CHLORIDE WITH S/V INDUSTRIAL WHITE OIL. FIGURES ON CURVES DENOTE PERCENTAGE BY WEIGHT OF CH_3CL IN LIQUID MIXTURE

Courtesy Refrigerating Engineering.

to the air should be avoided and, therefore, storage in closed containers is necessary. The use of small gallonage containers cuts down exposure to moisture but the oil may be stored satisfactorily in drums which are vented to the air when being discharged through a calcium chloride or soda lime drying tube.

Pour Point

Generally speaking, oils of low pour point are required so that they will not congeal in cold parts of the system and so that their free flow at low temperatures will prevent the formation of heavy insulating films on the inside of evaporator tubing. However, an extremely low pour point oil is not needed with methyl chloride, even for very low temperature work, as small amounts of methyl chloride greatly lower the pour point and the evaporator solution presents no additional heat transfer problem. This is shown by the following figures (2):

% by Weight Methyl Chloride in Oil	Pour Test
0.0	10.4° F.
1.7	—9.4
2.6	—20.2
3.3	—25.6

Although oils and methyl chloride are miscible in all proportions at temperatures where both exist as liquids, if an oil is not very well dewaxed the wax constituents may precipitate out of methyl chloride solution at low temperatures. Methyl chloride at —10.6° F. dissolves only .04% by weight of a paraffin melting at about 130° F. but solubility in presence of oil would be higher.

Acidity

An oil that is not neutral or very close to it may be corrosive and in addition may contain unstable constituents. Sulfuric acid refined oils may develop slight acidity after storage or use and an oil should be selected which not only is of low or zero initial acidity but also stays low in acid.

Flash Point, Saponifiable Matter, Sulfur

The flash point of an oil indicates the temperature at which it starts to give off inflammable vapors. It gives an indirect measure of relative volatility of an oil and also of homogeneity—that is whether or not it consists of a heavy base thinned with light constituents. To a limited extent, it is one of the criteria of stability. It is desirable to select an oil with a flash point above maximum operating temperatures and the general run of available refrigeration oils easily meet this requirement.

Oils containing saponifiable matter are unstable under conditions existing in refrigeration systems. They break down at higher temperatures, oxidize easily and may be hydrolyzed by water to form organic acids. Oils of animal or vegetable origin such as castor oil are saponifiable.

Oils should contain no corrosive sulfur. Also sulfur compounds, originally non-corrosive, may break down under the influence of heat or oxygen in air to form corrosive compounds, bad-smelling compounds and residue. There is some evidence that sulfur in certain forms may increase the tendency of oils to oxidize.

Stability—Sligh Oxidation Number

Oils used in refrigeration equipment, especially small automatic types, are expected to give service over a long period of years with little or no change in characteristics. It is, therefore, of highest importance to select an oil that will not form sludge or gummy substances under operating conditions.

No one laboratory test measures the stability factor in its broadest sense. External conditions affecting stability include operating temperature and the presence of air, water and acid, nature of refrigerant and nature of the metals or other construction materials in contact with the oil. Some of the qualities of the oil itself which are related to stability and which have been noted before are flash point and content of sulfur compounds, acid, moisture and saponifiable matter. The most important type of laboratory test for stability is an oxidation test such as the Sligh or Holde German Tar test. The former was used in developing desirable specifications for oils used with Methyl Chloride and, therefore, is used in this discussion.

The Sligh oxidation number of an oil is a measure of its tendency to sludge when in contact with oxygen at an elevated temperature. The oxidizable constituents are generally unsaturated compounds and it appears that these, being more reactive generally than the saturated, have a greater tendency toward sludging, gumming and carbonizing even when oxygen (air) is not present. The Sligh number is, therefore, fair measure of the general stability of an oil.

Oils of very low Sligh oxidation number range from pale yellow to water white in color and come into the class referred to as "highly refined." It is often claimed that the refining removes some of the lubricating value along with the color. This may be true, but certainly not to a dangerous extent as pale and white oils are commonly used with methyl chloride with entire satisfaction. The only important objection to them is initially higher price.

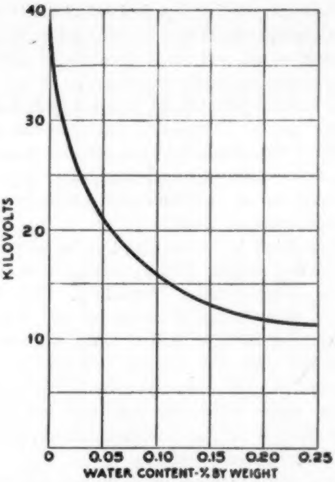

FIG. 3. RELATION OF OIL DIELECTRIC STRENGTH TO MOISTURE CONTENT

Courtesy Refrigerating Engineering.

Copper Plating

For a number of years after methyl chloride was first introduced in this country, the need for using a well-refined oil was not recognized and occasionally a condition described as copper plating developed in methyl chloride compressors. The copper was deposited as a thin film on iron and steel parts, usually wearing surfaces and parts subjected to higher temperatures, and in bad cases this film might interfere with the proper functioning of pistons, valves and seals and might even peel off and block the expansion valve. Machines doing heavy continuous duty and, therefore, operating at higher temperatures, for example ice cream machines, proved to be particularly subject to the condition.

Intensive research by an oil company, a manufacturer of methyl chloride compressors (the Servel Company) and The R. & H. Chemicals Department (at that time the only manufacturer of methyl chloride in

this country), developed the fact that copper plating could be avoided by proper selection of oil and since then the condition has been practically eliminated. It has always been possible to correct occasional cases that have arisen by charging the machine with a highly refined oil and keeping the system dry although this latter point is merely one of suspicion and not backed by experimental evidence.

The Sligh test was found to be useful in indicating copper plating tendency as well as in giving an index of stability. Some machine manufacturers insist on oils with a Sligh test of less than 2 while others are satisfied with oils running between 10 and 15 and the difference may be in the conditions under which the machines are used. The results of the experimental work may be summarized as follows:

A large number of tests on machines charged with less highly refined oils produced copper plating not only when ordinary precautions were taken for removing air and moisture, but also when the machines were flushed with nitrogen to remove air and every precaution was taken to exclude and remove moisture. With highly refined oils, there were no copper deposits even under the following conditions:

(a) Moisture present
(b) Moisture and air present
(c) Aqueous hydrochloric acid present
(d) Ordinary precautions taken for removing air and moisture

Other machine tests and laboratory tests on sealed tubes containing a large number of combinations of methyl chloride, oils, moisture, air, metals, acid, copper salts, etc., also pointed to low refined oils as the offenders. Analysis of oil from a machine in which copper plating was experienced showed that copper was present as an organic compound not as the salt of a mineral acid.

The original theory of copper plating was that hydrochloric acid, formed from moisture and methyl chloride, attacked copper and the resulting copper chloride deposited metallic copper on iron by electro-chemical displacement. The above tests did not substantiate this theory, although they also did not definitely show the actual nature of the involved reactions. However, it appears that the lower refined oils either contain substances or may be oxidized to substances which attack copper-forming organic copper compounds which are then decomposed on hot surfaces and deposit metallic copper. High temperatures, moisture, air and sulfur compounds may contribute toward the effect and these should be eliminated as far as is practically possible.

It is probable that copper plating that has been experienced with some other refrigerants can be eliminated in the same way as has been found successful with methyl chloride, but we have no data bearing directly on this. At any rate copper plating reported as occurring in automobile engines was also reported as stopped by using a different oil.

Glycerine has been proposed and used as a lubricant of the insoluble type for methyl chloride compressors. At 77° F. and saturation pressure, liquid methyl chloride dissolves only 0.05% by weight glycerine while under the same conditions, glycerine dissolves only 0.3% by weight methyl chloride. It is heavier than liquid methyl chloride, and, therefore, lubricant which separates must be drawn from below the liquid refrigerant. The main objection to glycerine is its very strong tendency to absorb moisture when in the dehydrated state so that careful technique is required to obtain a dry system. Moisture, of course, must be eliminated because of possible undesirable reactions and corrosion. However, while quite a few machine manufacturers have had disappointing experiences with glycerine, at least one has used it successfully. Since the industry has learned how to use mineral oils with methyl chloride, the demand for an insoluble lubricant has disappeared except for certain types of equipment.

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Installing and Servicing *(4th Article)*

Copeland Commercial Equipment

Concluding Instructions on Construction and Servicing of Thermostatic Expansion Valve, Controls, and Miscellaneous Servicing Suggestions.

THE Copeland thermostatic expansion valve is similar to the standard expansion valve, in which the adjusting spring and nut have been replaced by a flexible bellows and a fiber push rod. The bellows is connected by a small tube to a "frost control bulb" which is filled with a volatile liquid. Instead of having a fixed external pressure against the internal expansion valve bellows, with a corresponding fixed or constant suction pressure maintained with the regular expansion valve, we have the external pressure controlled by the temperature of the frost control bulb so that the suction pressure will correspond to the temperature of the expansion coil in the cooling tank. As the temperature is lowered in the expansion coil, the needle valve closes.

The body of the thermostatic expansion valve, illustrated in Fig. 20, is practically the same as that of the standard expansion valve. The extra parts which are added to change a standard into a thermostatic expansion valve are indicated on this diagram, as follows:

AA—Fibre push rod.
BB—External bellows balancing spring.
CC—Frost control bellows.
DD—Adjusting cap.
EE—Internal bellows balancing spring.
FF—Control vapor chamber.
I I—Bakelite spool.
J J—Capillary tube.
KK—Liquid chamber of control bulb.
LL—Frost control bulb.

When the bulb "KK" is warm, pressure is built up in the bulb "LL," capillary tube "JJ" and the chamber "FF" in the bellows "CC." This pressure acts upon the fiber push rod "AA," forcing it down against the bellows plate "R" and the lever "H" which opens the needle valve "E."

When the bulb "KK" is cooled to a given temperature, the volatile liquid with which the bulb, capillary tube and bellows is charged, is condensed in the bulb and the pressure in the chamber "FF" is reduced to a point where the ten ion of the spring "J" overcomes the pressure in the chamber "FF." and the needle valve is closed, shutting off the flow of liquid refrigerant to the expansion coils.

To raise the temperature at which the needle valve closes, turn the adjusting cap "DD" to the left. This reduces the amount of refrigerant permitted to enter the expansion coil and results in a higher temperature.

To lower the temperature at which the needle valve closes, turn the adjusting cap "DD" to the right. Th's increases the amount of liquid permitted to enter the expansion coils and results in a lower temperature. A study of the illustration should be made until the function of this valve is thoroughly understood, for, as with all pressure reducing devices, it is the "heart" of the system.

The thermostatic valve has a compound action; that is, the needle valve is not only affected by the low-side pressure but also by the temperature of the coil at the suction elbow. The admission of refrigerant is controlled by the movement of the fibre rod, and this movement is governed by two opposing forces. As the refrigerant enters the body of the expansion valve, it builds up a pressure which tends to collapse the internal bellows, pushing the rod outward and closing the needle valve. If we placed a spring against the outer end of the rod, and compressed it so that the inward force balanced the outward force against the rod when a certain vapor pressure existed in the valve body, we would be able to maintain a constant and unvarying pressure in the low-

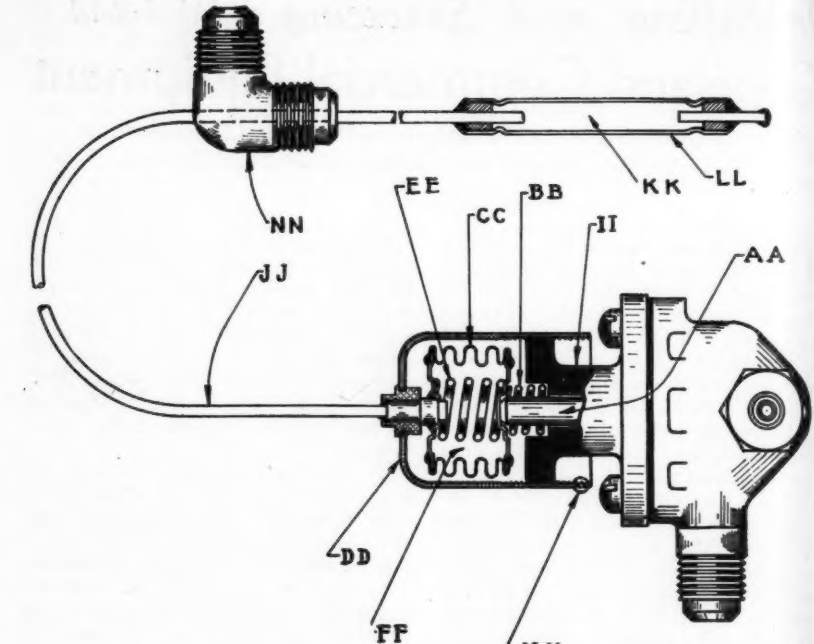

FIG. 20. EXPANSION VALVE AND FROST CONTROL ASSEMBLY

side, for as soon as the pressure rose or fell in the valve body the resultant motion of the internal bellows would immediately open or close the needle valve to restore balance.

Now suppose we add an external bellows, as shown in Figure 20, with a capillary tube and bulb attached. If the bulb is placed in a tank of water which is kept at a constant temperature, the pressure in the bellows will consequently remain the same. Therefore, the suction pressure will always be constant because the action of the external bellows would be similar to a spring or other fixed force. The suction pressure can only be increased or decreased by turning the frost control cap to change the spring pressure, or changing the bellows pressure by raising or lowering the temperature of the water surrounding the bulb.

In actual practice the valve is not set or given the final adjustment according to a gauge reading, as we do the standard expansion valve, but merely by observing the frost formation on the coil. The cap is screwed down far enough to "carry" the frost line to the outlet connection, and the bulb placed at that point will automatically control the suction pressure thereafter.

To demonstrate that the thermostatic valve is not governed entirely by the temperature of the frost bulb, two refrigerators may be connected to one condensing unit through a common suction line, and keep one coil from operating by closing the line valve. When the other coil has become quite cold and the suction pressure has dropped to 10 lbs., the other coil may be opened and allowed to cool. The pressure on this second coil will be 30 or 35 lbs., due to the warm frost bulb, and this pressure, being higher, will flow through the suction line into the colder coil. If the refrigerant were to flow through the first coil at a high pressure while it is cold, the suction line leading to the condensing unit would frost back; but the coil will not receive any liquid refriger-

ant for when the high pressure of coil No. 2 is admitted to the system, the internal bellows of the expansion valve on coil No. 1 promptly collapses, closing the needle valve completely.

The first coil will now begin to rise in temperature while the second one is being cooled. When their temperature at the suction elbows becomes approximately the same and if the frost control caps are similarly adjusted, the expansion valve on the first coil will again open and both will be in operation. If the first valve had not been influenced by the manifold suction pressure, it would have remained open resulting in frost back, as mentioned above. This operation is described at length because there seem to be many service men who entertain the impression that thermostatic valves are actuated solely by frost bulb temperature. If this were the case, the internal bellows could be discarded.

Balancing Valves

In balancing two or more valves, proper results are not immediately obtained when one frost adjusting cap is turned to change the setting. This is due to the influence of the other valves on the manifold suction pressure. One-half turn per minute is fast enough for the coils, and tanks with a "hold-over" should be adjusted at an even slower rate. The control, if it is of the pressure type, should also be readjusted when any major change is made in the adjustment of the thermostatic expansion valves. The adjustment cap must never be completely removed from the expansion valve body, as this will result in complete destruction of the charged bellows.

If the thermostatic expansion valve should be in need of further regulation, the first step is to examine the frost condition of each coil. For refrigerator temperatures of 40° and higher, frost or ice seldom appears on the cooling fins, only on the expansion coil itself which contains the refrigerant. When colder temperatures (36 to 40°) are required, frost will naturally form to some extent on the fins during the period of compressor operation, but will melt into drops of water during the idle parts of the cycle. At box temperatures under 36° it is difficult to obtain a freezing-melting operation and the spaces between the fins may become choked with frost, necessitating daily defrosting. No ordinary market refrigerator, however, requires such low temperatures, 38° being considered the coldest point desirable.

It has been explained that the absorption of heat by the refrigerator should cease at the section elbow of the coil. The frost control bulb is attached at that point to regulate the suction pressure accordingly. Considerable latitude is built into the valve adjustment and the frost control is sufficiently self-adapting to perform correctly even when it is not set absolutely accurately, but the cap must be adjusted within reasonable limits to obtain proper results. Generally speaking, the highest possible suction pressure is best for compressor efficiency but there is a limit in this respect for, as the pressure is increased, temperatures must be increased also. Low temperatures demand low boiling points; low boiling points, low suction pressure.

In its passage through the coil, the methyl chloride absorbs heat from the tube and is boiled or evaporated in doing so, changing from liquid to a vapor state. As soon as it becomes dry, its energy has been dissipated and no further heat can be picked up from the tube.

The adjustment of each thermostatic expansion valve should be such that some liquid refrigerant travels far enough along in the evaporator to reach and chill the frost control bulb inserted in the outlet connection. The simplest way to test the expansion valve is to turn all of them "in" one-half turn at a time until frosting back is noticed, then unscrew the caps just enough to overcome the frosting of the suction line. Do not, however, attempt this with only one coil at a time, but change them all, for they are connected in parallel and each is influenced by the pressure of the other.

Adjusting

Should any particular coil appear to be less cold than the others or if it is frosting the line outside of the refrigerator, the cap can be turned one-half turn every minute until balance is restored. It is understood, of course, that no change in the valve regulation should be made unless the unit is operating. It should be noted that the removal of the frost control cap will ruin the valve

mechanism. Do not turn it beyond the point where the threads on the flange are exposed.

The unit is apt to stop for a short time before the service man leaves the job, and the new owner may call attention to the warm temperatures still existing in the refrigerator. This condition is perfectly natural. The unit has stopped because the coils are cold and several operating cycles will have to be completed before the cabinet temperatures are lowered satisfactorily.

We now come to the discussion of a duty that is very often treated lightly by installation men, that of thoroughly inspecting their own work. The man who throws his tools together and leaves the premises almost as soon as he throws in the switch will find, in the majority of cases, that something is left undone or forgotten. Little things become big things if they are neglected. We list a few as examples:

1. Align belt with flywheel and adjust for correct tension.

2. Tighten motor pulley and flywheel set screws.

3. Tighten cap screws on compressor—particularly the cylinder head screws.

4. Tighten nuts or cap screws holding shut-off valves.

5. Tighten all unit hold-down bolts.

6. Go over wiring. Are all splices taped and concealed?

7. Is the conduit and motor properly grounded?

8. Is all tubing securely fastened in place?

9. Are the holes in the refrigerators sealed?

10. Are the motor bearings filled with oil?

11. Did you clean up all evidences of work?

It might be well at this time to check the direction of rotation of the compressor to prevent the possibility of its being reversed. These compressors have oil grooves in the crankshaft to assist lubrication in the main bearings and their action is defeated when the shaft is revolved in the wrong direction. The compressor should turn counter-clockwise when viewed from a position in front of the condensing unit.

Temporary arrangements or makeshifts are always avoided by first-class workmen. Cabinets that have been used for some time with ice are usually water-soaked and the extraction of this water by the somewhat drier air of mechanical refrigeration will cause the cooling coil to condense a great deal of moisture, but this condition will gradually correct itself. If any cooler has ill-fitting doors or if the gaskets are torn or lifeless, recommend that they be replaced. Should the owner be unwilling to do this, insert corkboard gaskets between the hard-

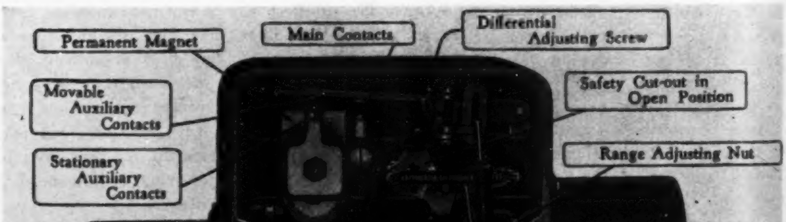

FIG. 21. PENN PRESSURE CONTROL WITH SAFETY CUTOUT

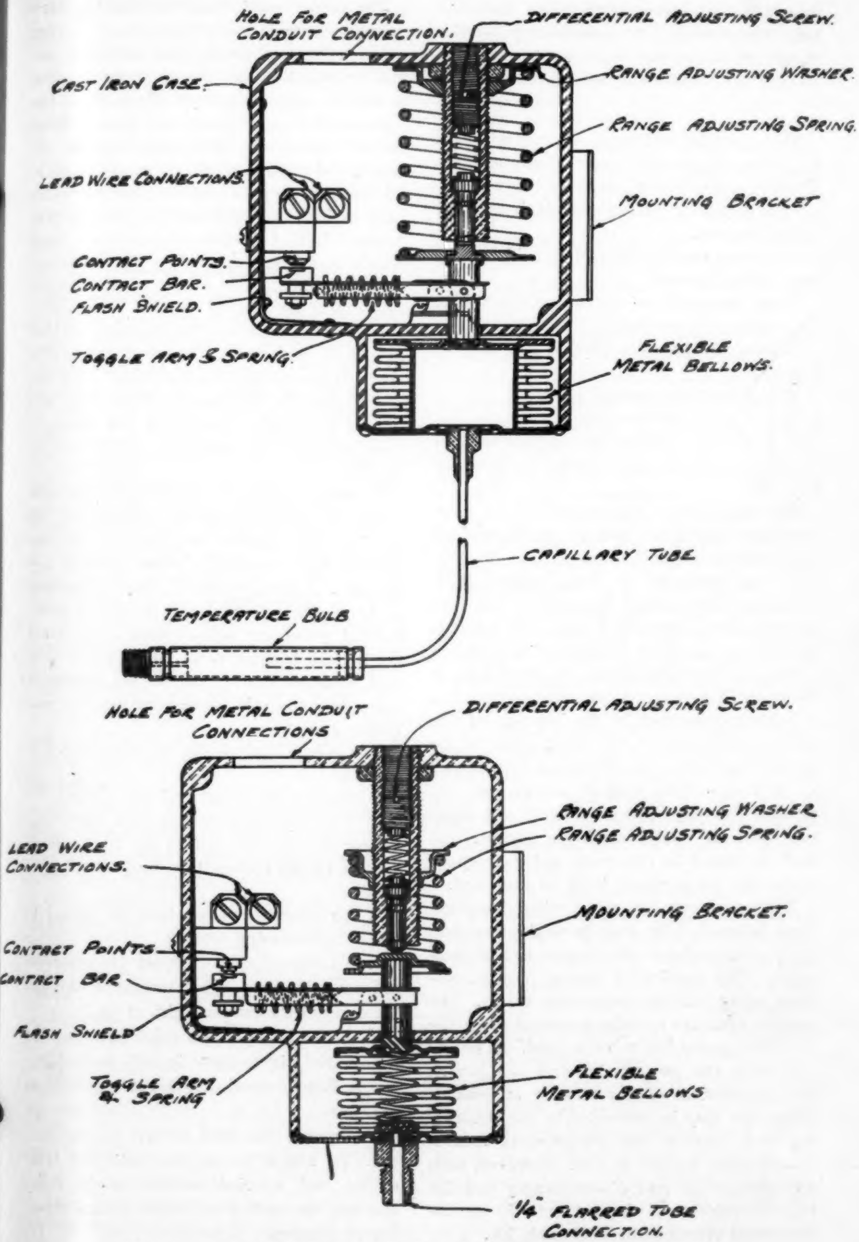

FIG. 22. TYPICAL CONTROLS USED ON COPELAND EQUIPMENT

ware and the surface of the door. This will help temporarily. A complete inspection should be made the following day without waiting for a call from the owner.

Controls

There are several types of controls used in commercial work to cover all applications. Those that are in use are listed below:

Penn pressure control with high pressure safety cut-out.

Penn temperature control with high pressure safety cut-out.

Penn temperature control without high pressure safety cut-out.

(These controls are similar to that in Fig. 21)

B & B pressure control.

B & B temperature control.

B & B water cooling temperature control.

(These controls are similar to those in Fig. 22)

The function of any control is to automatically maintain certain predetermined temperatures regardless of whether the control is of "pressure" or "temperature" type. A temperature control is simply a pressure control with a gas-filled tube and bulb attached to the bellows to furnish the actuated pressure. The adjustment of either type is therefore the same. A pressure control has a bellows connected to the low-side of the system and part of the refrigerant in the suction line flows into the bellows to expand it. A temperature control has its own expansion element which is distinct and separate from the refrigerant in the system. The bulb is placed in the refrigerator or space where the temperature is to be governed.

A pressure control can control temperatures because of the drop in suction pressure that accompanies a reduction in coil temperature. This applies, of course, only to systems using multiple expansion valves. The suction pressure remains constant when the standard expansion valve is used. In multiple work, one pressure control can govern the temperature of any number of coils or tanks that may be connected to one condensing unit, whereas the temperature control is ordinarily limited to one. However, each has advantages and disadvantages and the type to select will depend entirely on the individual circumstances of each job.

The terms "cut-in" and "cut-out" are frequently used in describing the operating characteristics of condensing unit valve control or switch. They simply mean the temperatures or pressures at which the device opens and closes or starts and stops. "Differential" means the difference between the cut-in and cut-out points. If a unit starts at 25 lbs. and stops at 10 lbs., the control is said to have a differential of 15 lbs. The "range" is that portion of a pressure chart which would be embraced by the cut-in and cut-out points. The range of the control above was 25 lbs. to 10 lbs. Commercial refrigeration requires closer regulation than household and so all Copeland commercial controls are equipped with both a range and a differential adjustment. With these one is able to achieve practically any temperature as well as operating cycles of any length.

In responding to a service call which indicates the need for control adjustment, the service man should consider the circumstances very carefully before making any changes. A decision should first be reached as to whether a change in the cut-in point, cut-out point, or both, would bring about the desired improvement. Make a record of such changes on a card or tag concealed somewhere near the condensing unit for your future guidance.

The B & B control, Fig. 22, is regulated as follows:

1. Remove the front and rear covers.
2. To lower the range, turn the large spring and knurled nut to the right, allowing the spring to lengthen, thus reducing its tension.
3. To raise the range, turn the spring to the left, increasing tension.
4. To raise the cut-in point (increase the differential), turn screw extending through the cover of the case to right, or "in."
5. To lower the cut-in point (decrease the differential) turn screw to left, or "out."

The Penn control, Fig 21, is regulated as follows:

1. Remove the front cover.
2. To lower the range, turn the large spring and knurled washer to the right, allowing the spring to lengthen, thus reducing its tension.

3. To raise the range, turn the spring to the left increasing tension.

4. To raise the cut-in point (increase the differential), lower the bottom limit of the slot in which the connecting link travels by turning small screw at side of slot.

5. To lower the cut-in point (decrease the differential), raise lower limit of slot to shorten travel of link. The differential adjusting screw is located at the top directly in front.

Servicing Suggestions

Recharging of Systems. If a leak is suspected in any part of the condensing unit, that part can be removed and submerged in water under air pressure. A leak will be indicated by bubbles. In charging a system, the following procedure should be followed: When checking units for leaks use an alcohol torch with rubber suction hose attachment. When holding hose near sealed joints a leak is detected by a green flame. Always "weigh-in" the methyl chloride. Charge unit through the compressor by evacuating the drum in an upright position. This distillation purifies the vapor, leaving dirt and scale in the drum. Do not hasten the recharging process by inverting the drum. Purge air from drums before withdrawing refrigerant.

When discharging refrigerant of questionable purity, run a 1/4 in. line to a window and discharge it outside. Do not attempt to estimate the amount of refrigerant in a unit by noting the head pressure. Use warm water, not a torch to a drum during evacuation. Charge units through a system dryer when using methyl chloride taken from another unit. Do not continue evacuating into a drum until the compressor stalls. This is dangerous for space must be allowed to remain for liquid expansion.

To remove refrigerant from a system, the following procedure should be used. Insert a compound gauge in the "A" valve. Attach drum to "B" valve with charging fitting and place drum in cold water. Close "B" valve to condenser. Open valve on drum. Open by-pass valve slightly. Operate compressor until gauge indicates 10 in. vacuum. Open "B" valve to build up pressure to 2 lbs. Close drum and detach.

To replace refrigerant, the following procedure should be followed. Refer to Fig 12, December, 1935 issue, page 16. Close "B" valve to condenser, open "C," and open "A" half way. Attach 1/4 in. line to "B" valve to catch oil. Attach drum to "A" valve. Operate compressor until pumping ceases. Remove oil line and place gauge in "B" valve. Open "B" and close "C" valve. Open valve on drum. Operate compressor until proper amount of refrigerant is admitted. Drums should be hung on suspension scales and weight observed during charging process. Close valve on drum. Open "A" valve and insert gauge. Open "C" valve and start machine.

Removal of moisture. The presence of moisture in any refrigerating system may result from any of the following sources: improperly dried out tubing; lubricating oil containing moisture; careless handling of methyl chloride charging drums; removing any part of the low-side under vacuum when colder than room temperature.

New jobs can be air dried before admitting refrigerant for the first time. Circulating air through the system is accomplished by attaching the 1/4 in. liquid line to compressor head through the system dryer, operating the compressor with the refrigerant trapped in the liquid receiver. In case the condensing unit contains any refrigerant, the dryer and 1/4 in. liquid line can be attached to the liquid receiver in the regular manner and the system operated with air instead of refrigerant. When drying with air the compressor "A" valve should be wide open so that the same air recirculates through the system. Do not allow the unit to draw in air continually.

To add a dryer to a system in operation, the following procedure should be followed: Close the "C" valve and run the machine until a 10 in. vacuum is reached; open valve "C" slightly to increase pressure to 2 lbs.; remove 1/4 in. liquid line from receiver; attach short length of tubing from dryer to liquid receiver; open "C" valve for an instant to purge air from dryer; attach 1/4 in. liquid line to dryer; open "C" valve and start compressor. Allow the dryer to remain in line approximately two hours. The same method is used in removing the dryer that is used in inserting it. Open both ends of the dryer after the operation, clean the

strainers, and refill with a sufficient charge of calcium chloride. The ends must be sealed with blind flares or sealing caps to prevent the absorption of moisture from the air.

Use of liquid filter. Some of the condensing units are equipped with a new type liquid filter which is placed in the liquid line at the "C" valve. A short length of tubing must be attached to the removable end which is fastened to the liquid receiver of the condensing unit. The high pressure liquid line is to be attached to the opposite end of the filter which is identified by the flare connection and body of the filter being of one piece. Care should be taken to insure that the ends are not reversed, as the liquid flowing from the receiver should first enter the strainer screen of the filter and then flow through the main body. To reverse this position may result in a collapsed strainer screen which would render it unfit for further use. When properly fitted, all accumulations of dirt will be in the body which can be quickly and easily removed after disassembling the liquid filter.

The first concern of the service man upon arrival at the job should be a careful analysis of the conditions he finds and those reported to him by the owner or caretaker. He should clearly understand the causes of incorrect operation and their remedies before making any attempt to repair or adjust any part of the refrigerating equipment.

Ice Water Generators

Ice water generators should be installed as follows: (See Fig. 23.) connect the suction line strainer at the suction line fitting on the expansion coil, using litharge and glycerine on all of the threaded joints; connect the suction line to the suction line strainer; connect the free end of the suction line to the "A" valve on the compressor; connect the expansion valve adapter to the inlet side of the expansion coil; install the expansion valve on the adapter, being sure that the joint is made up firmly and evenly; connect the expansion valve to the "C" valve with ¼ in. tubing; a No. 7000 system dryer should be installed in the liquid line between the liquid filter and the "C" valve; mount the temperature control on the wall above the cabinet; fill a small vessel with ice and water to be used in setting the control; after the ice and water have stood for several minutes, immerse the control bulb in the ice water and adjust the control so that it will cut out when the temperature of the water is at 35 or 36°; after the control has been set, remove some of the ice and permit the temperature of the water to rise to 43 or 44°, at which point the control should be set to cut in; insert the control bulb in the "dry well" which is located inside of the cold water discharge pipe; seal the open end of the dry well; evacuate the system and test for leaks in the manner required for any other type of commercial systems; open the

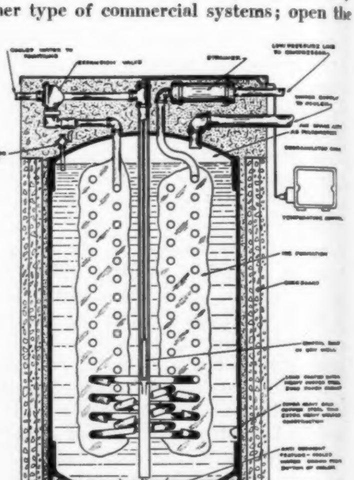

FIG. 23. ICE WATER GENERATOR

small air purging cock on the top of the generator shell to permit the escape of air when water is admitted to generator; admit water to generator; when water escapes at the purging cock, the cock should be tightly closed; start the condensing unit in operation; adjust the expansion valve at 25 lbs. back pressure and permit the system to operate at this pressure for about four hours with the system dryer in the liquid line; remove the system dryer and put the unit in normal operation. Any further adjustment affecting the temperature of the cold water as it leaves the generator may be made after one day of operation.

Setting Expansion Valves and Pressure Controls

Efficient Operation Is Dependent Upon the Proper Setting of Expansion Valves and Pressure Controls. This Article Contains Some Service Pointers for Various Classifications of Refrigeration Service.

By **GEORGE CLARK, B.S.M.E.***

IN service, it is quite necessary to know what the proper setting for an expansion valve may be in an expansion valve system and in any system using a pressure control it is quite necessary to know at what pressure the control should be adjusted to close and open. The various manufacturers usually run tests on their particular combination of condensing unit, evaporator and refrigerator in their laboratories to determine what is the best suction pressure to use for their particular refrigerator. Thus they make certain recommendations on how to set a valve. However, a person thoroughly familiar with the refrigerants and having some experience to guide him, may easily estimate the suction pressure at which to operate a particular type of evaporator on any refrigeration job.

In the older style refrigerators which made use of comparatively large brine tanks as the evaporators, the brine tank usually operated at an average temperature of 20°. This was one stage in the evolution of the ice box into the electric refrigerator. The brine tank took the place of a cake of ice. It was slightly smaller than the cake of ice which it replaced and operated at temperatures somewhat lower than the cake of ice. In this case the difference is from 32° ice to the 20° brine tank. In order to obtain this 20° average temperature, the brine tank might operate between temperatures of 15° to 25°, 16° to 24°, or possibly 17° to 23°. With the large amount of coil in the brine tanks, it was only necessary to maintain a refrigerant temperature a very few degrees below the temperature of the brine while the machine was in operation in order to cool the brine. Thus where a temperature of 16° to 24° was maintained, sulphur dioxide in the tube of the tank would refrigerate at a temperature of about 14° when the whole coil in the brine tank was in use. After the full coil was in use, a frost back occurred on the suction line and cooled a control bulb, shutting off the control opening the control circuit and stopping the motor. As the temperature of the brine and refrigerant rose to 24°, the temperature control would have warmed up and closed the control circuit and the machine would be in operation again.

Evaporation and Condensing Temperatures

The following table shows the corresponding evaporation and condensing temperatures and the corresponding vapor pressures for "Freon," methyl chloride and sulphur dioxide and Isobutane.

	"Freon"	Methyl Chloride	Sulphur Dioxide	Isobutane
0°	9.2 lbs. g.	4.0 lbs. g.	8.5 in. vac.	6.2 in. vac
2°	10.2	4.8	7.5 in.	5.0 in.
4°	11.3	5.7	6.5 in.	3.8 in.
6°	12.3	6.6	5.0 in.	2.8 in.
8°	13.5	7.6	4.0 in.	1.6 in.
10°	14.7	8.6	2.5 in.	0.2 in.
15°	17.9	11.1	0.5 lbs. g.	1.6 lbs. g.
20°	21.1	14.1	2.5	3.5
25°	24.8	17.2	4.7	5.5
30°	28.5	20.5	7.0	7.6
32°	30.0	22.0	8.0	9.0
35°	32.5	24.0	9.6	9.8
40°	37.0	27.9	12.4	12.2
50°	46.7	36.8	18.8	17.8
60°	57.7	47.0	26.2	24.
70°	70.1	58.7	35.	31.
80°	84.1	72.	45.	39.
90°	99.6	87.	56.	49.
100°	117.	104.	70.	59.
110°	136.	122.	85.	70.
120°	157.	141.	106.	83.
130°	180.	161.	122.	97.
140°	205.	185.	144.	112.

* Detroit School of Refrigeration. Chairman National Educational and Examining Board, R. S. E. S.

Thus if in the brine tank refrigerator of the old type the evaporation temperature of 14° is desired, a pressure equal to that of the atmosphere was used to obtain that evaporation temperature with sulphur dioxide. With Isobutane, which was used in the old Copeland refrigerators, the pressure would be slightly higher than atmospheric pressure. With methyl chloride the pressure would be somewhat over 10 lbs. gage pressure. If "Freon" were to be used in a similar system, the gage pressure of approximately 17 lbs. would be required.

As the refrigerators continued their evolution, the size of the evaporators decreased and the evaporator temperatures were lowered. In the early style refrigerators making use of a cold control, that is an adjustable temperature control for varying conditions, it was usually necessary to evaporate the refrigerant at temperatures from 6° to 8° in order to insure that the control would turn off when set in the coldest position. With sulphur dioxide, this has given suction pressures of from 4 inches to 5 inches of vacuum.

In still later types of refrigerators, the evaporators have been still further reduced in size and the temperatures also have been further reduced. This is required in order to get the quick freezing of ice cubes and the ability to freeze desserts rapidly, which the public now demands. Thus at the present time refrigerant temperatures of from minus 4° to plus 6° are usually obtained in the evaporator. With sulphur dioxide this may give us suction pressures of from 5 inches to 10 inches of vacuum. With methyl chloride the pressures are correspondingly higher and the vapor pressure may often be such that a higher evaporation temperature is indicated for methyl chloride, "Freon" or Isobutane than is required for sulphur dioxide. This difference is apparently required due to the fact that the rate of heat transfer from sulphur dioxide to the outside of the tube is somewhat slower than it is for methyl chloride or the other refrigerants, with the same difference in temperature between refrigerant and the outside of the tube. This is usually explained by stating that a slight oil film acting as an insulator forms on the inside of the tube in which the sulphur dioxide is evaporating due to the fact that the oils do not usually go thoroughly into solution with the sulphur dioxide.

Vapor Pressure

In setting pressure controls it is well to keep in mind what happens in the refrigerating system and certain temperature pressure relations of the various refrigerants with which we should become familiar. One vapor pressure that is important in any consideration of a pressure control setting is that vapor pressure which corresponds to 32° evaporation for the various refrigerants. With "Freon" this pressure is approximately 30 lbs.; with methyl, 22 lbs.; with sulphur dioxide, 8 lbs.; and with Isobutane about 9 lbs. It must be borne in mind also that in any refrigerating system while the machine is in operation and the refrigerant is evaporating, the refrigerant temperature itself will be somewhat lower than the temperature of the evaporator in which it is located. Thus if the refrigerant is evaporating at 0°, the evaporator may be at temperatures ranging from 3° to 10°, depending on the size of the condensing unit, the size of the evaporator and the conditions of air temperature and circulation around the evaporator.

Multiple Systems

In a multiple household refrigeration system, we ordinarily want to keep the evaporator frosted at all times except during a defrost period. Thus also it is well to keep in mind that the temperature of the refrigerant and the temperature of the evaporator while the machine is not in operation will be very nearly the same, there being not more than 2° or 3° difference at the most. So that the evaporation temperature of the refrigerant as the evaporator warms and until the control starts the motor should be below the 32° temperature so as to prevent any defrosting. Usually it is advisable to maintain this highest temperature in the evaporator in the neighborhood of 25°. If we require a 0° refrigerant temperature with sulphur dioxide, that would thus give us a pressure control setting of approximately 8½ inches vacuum as a cut-off pressure and approximately 5 lbs. gage pressure as a cut-in pressure.

If in a commercial coil it was desired that the coil would thoroughly defrost during the shut-off period, we would want the coil to warm up to a temperature several degrees above our frost temperature, 32°, so as to insure that all frost is melted off the coil before the machine is again operated. With sulphur dioxide, if we set our pressure control to operate from 8½ inches vacuum at the cut-off point to 10 lbs. gage pressure at the cut-in point, that would give us refrigerant temperatures varying from 0° to 36°. During the on period, the coils would frost and become quite cold and cool the surrounding space. During the off period the coils would warm up and the temperatures become very nearly equal to that of the surrounding space and on warming up to 36° would have become thoroughly defrosted; when the machine is again put in operation.

Ice Cream Cabinet Settings

If we were to set a pressure control on a machine which is to be used in conjunction with an ice cream cabinet which is to maintain an average brine temperature of 5°, we might allow ourselves a temperature variation of from 2° to 8°. With sulphur dioxide it would be necessary to use an evaporation temperature of approximately 10 inches vacuum as the cut-out point in order to insure that the brine was chilled down to 2°. The cut-on point which would correspond to 8° should be approximately 4 inches of vacuum. In some cases possibly due to air in the system or due to the fact that some of the refrigerant may be in part of the system which is not operating at the coldest temperature, we sometimes have a pressure at our compressor slightly higher when our machine is off than is indicated by the temperature of the evaporator. Thus for an ice cream cabinet, the cut-on pressure instead of being 4 inches as is indicated by our chart may be only 2 inches vacuum as a cut-on pressure.

Expansion Valve Settings

Tabulated below are various expansion valve settings suitable for use with the various refrigerants for uses indicated. In addition, pressure control settings which are usually found practical for the various uses indicated are given.

TABLE OF EXPANSION VALVE SETTINGS WITH GAGE PRESSURES

Type	SO_2	Methyl Chloride	Iso-butane
Household refrigerators, old style large brine tanks, no adjustable cold control.........	4 in. vac. to 0 lbs. gage	7 lbs. gage to 10 lbs. gage	2 in. vac. to 1 lb. gage
Brine tanks with adjustable cold controls....	7 in. vac. to 2 in. vac.	6 lbs. gage to 8 lbs. gage	6 in. vac. to 2 in. vac.
Brineless, dry type evaporators.........	10 lbs. vac. to 6 in. vac.	4 lbs. gage to 6 lbs. gage	8 in. vac. to 4 in. vac.
Water coolers indirect..	0—4 lbs. ga.	8 lbs. to 12 lbs. gage	0 to 5 lbs. gage
Ice Cream cabinets—brine...............	14 in. to 8 in. vac.	0 lbs. to 4 lbs.	....

Following is a list of pressures which have been found practical as pressure control settings for methyl chloride and sulphur dioxide in connection with the various types of refrigerating systems listed:

For *ice cream hardening cabinets* where average temperatures of from —10° to —20° in the cabinets are desired, pressure control settings of about 0 lbs. to 18 inches vacuum are suitable with methyl chloride. (Sulphur dioxide is unsuitable for temperatures as low as these.)

For *dispensing cabinets for package ice cream* which require temperatures of from 0° to 10 below zero, pressure control settings of from 10 inches vacuum to 4 lbs. pressure for methyl chloride are suitable. For SO_2 cabinets, to secure the same temperatures pressure control settings of 18 inches vacuum to 5 inches vacuum are suitable.

For *ice cream dispensing cabinets* requiring temperatures of from 0° to 10°, the pressure control may be adjusted from 4 inches vacuum to 8 lbs. pressure for methyl chloride; and from 14 inches vacuum to 0 lbs. gage for sulphur dioxide.

For *household refrigerators* using float type evaporators and pressure controls the pressure control settings which generally work out quite satisfactorily are those which will give refrigerant temperatures varying between 0 and 10° on the cut-off point and between 20° and 30° on the cut-in point.

For methyl chloride, pressures of 6 to 18 lbs. gage pressure are usually quite satisfactory, while with sulphur dioxide pressures

of 6 inches vacuum to 6 lbs. gage pressure are usually satisfactory.

In some cases to prevent short cycling it may be an advantage to increase the differential so that with methyl chloride pressures varying from 4 lbs. to 20 lbs. gage in an extreme case, while with sulphur dioxide a pressure of 9 inches vacuum to 7 lbs. gage pressure may be used occasionally in household or multiple apartment house systems.

For *meat coolers* requiring temperatures from 32° to 35°, using methyl chloride, pressure control settings for use in conjunction with finned dry type evaporators will require a cut-in pressure of 23 lbs. to 24 lbs. for methyl chloride and a cut-out pressure of from 6 lbs. to 12 lbs., depending on the capacity of the condensing unit. For sulphur dioxide the cut-in pressure should be 9 lbs. gage pressure and the cut-out pressure may vary from 10 inches to 6 inches vacuum, depending on the capacity of the condensing unit.

For *meat coolers* to operate from 35° to 40° using methyl chloride, pressure control settings of 25 lbs. cut-in and a cut-out of from 8 lbs. to 12 lbs. are usual settings. For sulphur dioxide a cut-in of 10 lbs. and a cut-out of 8 inches to 4 inches vacuum are usual settings.

For *vegetable or grocery coolers* requiring temperatures of 40° to 50°, the cut-in pressure may range from 25 lbs. to 30 lbs. for methyl chloride and the cut-out pressure may be from 8 lbs. to 14 lbs. For sulphur dioxide the corresponding cut-in pressure may vary from 10 lbs. to 16 lbs. and a cut-out pressure may vary from 4 inches to 2 lbs.

For *florists' coolers* operating at temperatures of 45° to 55°, the cut-in and cut-out pressures for methyl chloride may be raised approximately 5 lbs., and for sulphur dioxide 3 lbs. above those required for the vegetable coolers.

x x x

NEW WHOLESALE CATALOG

A NEW 64-page catalog of refrigeration replacement parts has been issued by Wholesale Radio Service Co., Inc., of New York, Chicago, Atlanta, and Newark. This lists thousands of individual parts for all popular makes of refrigerators, and also includes a seven-page technical section of suggestions for refrigeration servicemen.

Copies of this catalog can be obtained free of charge from any of the branches of Wholesale Radio Service Co., Inc., at the following addresses: New York, N. Y., 100 6th Avenue; Chicago, Illinois, 901 West Jackson Boulevard; Atlanta, Georgia, 430 West Peachtree Street, N.W.; Newark, New Jersey, 219 Central Avenue; Bronx, New York, 542 East Fordham Road.

Send a Picture and Win a Prize

THE editors are looking for pictures for publication either on the cover or in connection with articles. Pictures of installations—a shop picture, or any other picture of unusual interest showing applications of refrigeration will be accepted.

All contestants whose pictures are accepted for publication will receive a copy of the new book just published on "Commercial Refrigeration," described fully on page 55 of this issue. Send your pictures today.

x x x

APARTMENT HOUSE AIR-CONDITIONED

DELCO-FRIGIDAIRE CONDITIONING CORPORATION, air conditioning selling company of General Motors Corporation, has received from the New York State Realty & Terminal Company an order for the complete air conditioning of all apartments in the twelve-story apartment building at 400 Park avenue, New York City, it was announced today by James J. Nance, vice-president and general sales manager of Delco-Frigidaire.

The building, after process of remodelling, will consist of forty-four apartments ranging in size from four to six rooms each. There are four apartments to each floor, except the first, which is occupied by shops.

Under the system of air conditioning laid out for the building by Delco-Frigidaire engineers, Mr. Nance stated, each of the forty-four apartments will be individually air conditioned.

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THE

Question BOX

Readers are invited to send their problems pertaining to the servicing of household refrigerators and small commercial refrigerating equipment as well as oil burners to "The Question Box" which will be answered by competent authorities.

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THE following questions submitted to this department are answered by Mr. George H. Clark, chairman National Educational and Examining Board, Refrigeration Service Engineers Society.

Have any readers other opinions regarding the problems involved. Send them to the Editor.

Replacing High Side Float Valve

QUESTION 114. *We repaired a G-55 General Electric refrigerator which had a defective H. S. float and control power element tube broken and discharged. We found it was not possible to repair the needle and seat of the high side float because it (the seat) was welded into the top of the refrigerator. We removed the float, drilled through the base of the float housing, installed a liquid receiver behind the condensing coil, installed a filter and a thermostatic expansion valve on right side of evaporator brazed in new tubing and installed three-way valve at top side of liquid receiver so that the unit could be charged or purged in the field if needs be. We inverted the dome and dumped the old oil and gas out, dehydrated and recharged. We found the oil very thin and laden with steel dust. (The unit was over six years old.)*

We found that after the thermostatic expansion valve was installed, the coil was evidently kept more fully charged than it was before and that the compressor ran much more quietly than many of the same make with the high side float, and also ran less. We have found that General Electrics make quite a racket when the charge is low. With this system we find that the refrigerator operates very satisfactorily and the customer is very well pleased.

We would like to know what you believe to be a fair price for this work, including refinishing the dome and cabinet, new hardware, and re-tinning the shelves. The G. E. Distributor asked $65 for replacing the unit only. What is your opinion of this sort of assembly, and do you know of a way to repair the high side floats without installing the thermostatic expansion valve? If so, what is it?

It has been our custom for years to mix a quart of top cylinder Pyroil Collodial Graphite oil with five gallons of compressor oil. In the above job we used pure white oil, as we were afraid the graphite would have some effect upon the hermetically sealed motor. Can you tell us whether or not the graphite would affect the motor of this type unit?

ANSWER: I do not feel that I can properly advise anyone on the price to charge for a certain refrigeration job, as conditions in various parts of the country vary considerably both as to the cost of labor and as to the availability and cost to the service man of the parts used. In general a job using a considerable number of parts may be satisfactorily paid for in a return of a 40% profit on parts plus an hourly rate on labor. Where the amount of materials used is not so great, a charge of double the wholesale cost of the materials is usually considered equitable; and the total cost should, of course, also include the labor at the usual hourly rate. The cost of the job may also be concerned somewhat with the length of guarantee that may be given with the job. All in all, it is very difficult for me to advise anyone as to the proper price on a job of this kind where your conditions may be considerably different than prevail in this part of the country.

Where the high side float valve has become defective, I believe the only thorough way of repairing the job is to replace the float valve with a new one, possibly of some other make which is more obtainable. The use of the thermostatic expansion valve should be satisfactory; and if the motor and

pump are in good condition and the refrigerant is moisture free, it is probable that the refrigerator to be repaired should give considerable satisfactory service before further repairs are required.

The high side float valve can also be replaced, of course, by a capillary tube of proper size, provided that a screen is included ahead of the capillary tube so as to eliminate the possibility of plugging the capillary tube.

With respect to your oil problem, I have no experience in mixing the graphite oils with the compressor oils but I would say that it was entirely inadvisable to mix anything with the refrigeration oil. The motor used in the General Electric would not be affected by the graphite, as there are no contacts made except in the external starting device.

An article appears in this issue of the Refrigeration Service Engineer which goes into some detail on refrigeration oils.

Entropy

Question 115. *Will you please give a definition of Entropy. What does the r and T stand for which is written r/T in the entropy column in Lecture 3?*

Answer: Entropy is one of those things which is very difficult to define. The definitions which I have heard are generally quite complicated and to a person who does not understand what entropy is anyway, they do not help to clarify the meaning. The best definition I can give for entropy is this: Entropy is the base of a heat diagram, the altitude of which is absolute temperature and the area of which represents heat.

For instance, when adding latent heat to a pound of liquid refrigerant, we cause it to vaporize and become a gas. The heat we add is added at a constant temperature provided the pressure remains constant on the refrigerant during the addition of the latent heat. Thus the base of the diagram which pictures the heat quantity added is measured in entropy units and the absolute temperature is the Fahrenheit temperature plus 460°, since —460° is the absolute zero of temperature. The latent heat in B.t.u.'s then would be the product of the number of entropy units times the absolute temperature.

Since the diagram representing this latent heat is a rectangle, the area of the rectangle is equal to the base times the altitude. The r and T referred to in the middle entropy column as

$\frac{r}{T}$ refers to the latent heat of the refrigerant at the particular temperature which is given under the column with the letter "r" at the top. The "T" stands for the absolute temperature. The entropy change then during the addition of the latent heat is the area of the rectangle divided by the altitude of the rectangle. The area is the latent heat "r" and the altitude is the absolute temperature "T" so that the entropy change during the addition of latent heat is referred to as

$\frac{r}{T}$.

Floats

Question 116. *Are the new low-side floats such as Frigidaire and Kelvinator calibrated so the liquid level will be high enough that no oil will accumulate on top of it and yet have no spill over causing the suction line and probably the compressor to frost, or is such a condition possible without an oil separator in the discharge line of compressor?*

The reason I ask is that a friend of mine said he completely overhauled an apartment house multiple system and traded the old floats in on new ones and started the system to work without putting any oil in any of the boilers and checked the oil in the compressor several times over a period of two weeks and each time found a sufficient supply of oil in the compressor. The system used SO_2 as a refrigerant.

I have never been able to get the same results. Please comment.

Answer: It is possible that the new Frigidaire and Kelvinator floats are so designed as to cause more of the oil to return through the suction line than it was possible to return by means of the older style of float valves. However, it has been my experience that it is usually not necessary to put a very large quantity of oil in the evaporators. In fact, it has always been my preference to add the oil to the compressors whenever necessary

rather than to replace the oil in the evaporators themselves.

The oil returns from the evaporator to a large extent due to the foaming of the refrigerant and oil shortly after the machine starts operation. It seems to me that a blanket of oil over the liquid refrigerant in the evaporator may not always be necessary and it is doubtful if there will always be an oil layer present.

I believe the system will give best refrigeration when the compressor has sufficient oil but when there is a minimum of oil in the evaporators themselves.

Cooling Drinking Water

QUESTION 117. *I am enclosing a picture of a small refrigeration plant I built out of many parts for cooling the drinking water in the dormitory where I live. I have not been able to overcome a pounding noise in the Servel twin compressor. It is present only when starting up and after it has run for five minutes it disappears. I am using a Riley oil separator with automatic oil return to the compressor. The methyl chloride gas upon leaving the compressor seems to condense in the oil trap and is sent back into the crank case of the compressor. This causes the compressor to pump a liquid and some gas when starting up. After the oil trap has reached a higher temperature, the gas goes through the oil trap and enters the condenser.*

The small oil return line from the oil trap to the compressor crank case frosts up on every starting up. Would it do any good to insulate the oil trap and gas pipe lines on each side of it to hold the heat in the trap and prevent the condensing of the gas at the wrong place? Could the trap be located at some other place in the circuit? If I have not furnished enough information, I will be glad to do so.

Does the velocity of the gas from the compressor have anything to do with this trouble?

ANSWER: The installation of the oil trap which you show in connection with a water cooler and a Servel compressor is undoubtedly causing trouble due to the condensing of the refrigerant in the oil trap. This trouble is apt to develop in an installation of this kind where the machine is air cooled and the oil trap itself may have a temperature as low as the receiver or condenser itself.

You have suggested the remedy for this in

DRINKING WATER INSTALLATION

that the trap should be well insulated and, if possible, the line from the compressor to the trap should also be insulated.

The location of the trap is all right, but I should suggest that possibly a layer of hair felt might be wrapped around the trap and that it might also be filled in at the top.

This may not entirely eliminate the condition you have, but it should cut it down at least 90%.

Westinghouse Evaporator

QUESTION 118. *I have a customer who purchased a new Westinghouse refrigerator last November. The salesman told them the evaporator was made of brass. I would like to know if this is true, as I had not heard previously of brass evaporators. It is a hermetically sealed unit.*

ANSWER: I am informed by the Westinghouse Company that the new household refrigerator has an evaporator of the welded tubeless construction which is made out of a metal which they call "sanaloy" which is a metal resembling aluminum in appearance and may be somewhat similar to monel metal. They state that the evaporator is not made of brass.

x x x

F. C. Giese, California

The writer has been a reader of the REFRIGERATION SERVICE ENGINEER for some time and I am getting a lot of good out of your publication.

Si s and Quality Service . . .

ATLANTA, GA.
- Fedders Manufacturing Co.
- Leo Bosarge Refrigerating Equipment Co.

BALTIMORE, MD.
- Melchior, Armstrong, Dessau Co.

BOSTON (CAMBRIDGE),, MASS.
- Melchior, Armstrong, Dessau Co.

BRIDGEPORT, CONN.
- Parsons Bros.

BUFFALO, N. Y.
- Fedders Manufacturing Co.
- Beals, McCarthy & Rogers
- Root-Neal & Co.

CHICAGO, ILL.
- Fedders Manufacturing Co.
- Harry Alter Supply Co.
- H. W. Blythe Co.
- Borg-Warner Service Parts Co.
- George Monjian
- The Airo Supply Co.

CINCINNATI, OHIO
- Fedders Manufacturing Co.
- Merkel Brothers Co.

CLEVELAND, OHIO
- Debes & Company

DALLAS, TEXAS
- Fedders Manufacturing Co.
- Beckett Electric Co.

DAVENPORT, IOWA
- Republic Electric Co.

DAYTON, OHIO
- Allied Refrigeration Co.

DENVER, COLO.
- Auto Equipment Company

DETROIT, MICH.
- W. C. DuComb Company

FERNWOOD, MISS.
- Enochs Sales Company

GREENSBORO, N. C.
- Home Appliance Service Co.

HOUSTON, TEXAS
- Walter Refrigeration Supply Co.
- D. C. Lingo Company

INDIANAPOLIS, IND.
- Langsenkamp Company

KANSAS CITY, MO.
- Natkin & Company

LONG BEACH, CALIF.
- Allied Refrigeration

LOS ANGELES, CALIF.
- Fedders Manufacturing Co.
- Franklin G. Slagel
- United Refrigeration Products Co.

LOUISVILLE, KY.
- Geo. Dehler, Jr. & Co.

MACON, GA.
- Lowe Electric Co.

MEMPHIS, TENN.
- United Refrigeration Supply Co.

MINNEAPOLIS, MINN.
- Refrigeration & Industrial Supply Co.

NEWARK, N. J.
- T. W. Binder & Company

NEW ORLEANS, LA.
- Enochs Sales Co.

NEW YORK CITY
- Fedders Manufacturing Co.
- Melchior, Armstrong, Dessau Co.
- Aetna Supply Co.
- Paramount Electrical Supply Co.
- Servicemen Supply Co., Inc.
- Wholesale Radio Service Co.
- Harry Alter

PHILADELPHIA, PA.
- Melchior, Armstrong, Dessau Co.

PHOENIX, ARIZ.
- R. R. Reynolds Co.

PITTSBURGH, PA.
- William M. Orr Co.

PORTLAND, ORE.
- Stone Supply Co.
- Refrigerative Supply, Inc.
- Refrig. & Power Specialties Co.

SAN ANTONIO, TEXAS
- Strauss-Frank Co.

SAN FRANCISCO, CALIF.
- California Refrigerator Co.
- Refrigerator & Power Specialties Co.

SEATTLE, WASH.
- Refrigerative Supply, Inc.
- Refrigerator & Power Specialties Co.

SIOUX CITY, IOWA
- Refrigeration Supply Co.

SPOKANE, WASH.
- E. S. Matthews, Inc.
- Electric Refrigeration Company
- Refrigeration Parts Supply Co.

ST. LOUIS, MO.
- Harry Alter Co.
- The Spangler Company

ST. PAUL, MINN.
- Thermal Service Co., Inc.

VANCOUVER, B. C.
- Fleck Bros., Ltd.

WHITE PLAINS, N. Y.
- County Seat Plumbing Supply Co., Inc.

FEDDERS MANUFACTURING CO.

57 TONAWANDA STREET, BUFFALO, N. Y.

SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN MOTORS

CHART PREPARED BY AND REPRINTED WITH PERMISSION OF THE WAGNER ELECTRIC CORP., ST. LOUIS, MO.

PROBLEM	PROBABLE CAUSE	TEST AND REMEDY
(A) FAILURE TO START	1. Blowing of fuses or operation of overload device.	1. Examine motor bearings, be sure that they are in good condition and properly lubricated. Be sure motor and driven machine both turn freely. Check circuit voltage at motor terminals against voltage stamped on motor name plate. Examine overload protection of motor. Overload relays operating on either magnetic or thermal principles, or a combination of the two, offer adequate protection to the motor. Ordinary fuses of sufficient size to permit motor to start do not protect motor against burnout. A combination fuse and thermal relay such as the Buss Fusetron protects the motor and is inexpensive. If motor does not have overload protection the fuses should be replaced with overload relays or Buss Fusetrons. After installing suitable fuses and resetting overload relays, allow the machine to go through its operating cycle and if protective devices again operate, check the load. If motor is excessively overloaded take up with the appliance manufacturer.
	2. No voltage or low voltage.	2. Measure volts at motor terminals with switch closed. See that it is within 10% of voltage stamped on name plate of motor.
	3 Open-circuited field.	3. Indicated by humming sound when switch is closed. Examine for broken wires, loose connections.
	4. Improper current supply. Incorrect voltage or frequency.	4. Requires motor built for operation on power supply available. A.C. motors will not operate on D.C. circuit or vice versa.
	5. Condenser short circuited or open circuited.	5. See F.
	6. Improper line connection.	6. See that connections are exactly like connection diagram which is sent with motor. (See Figure 3.)
	7. Excessive load.	7. If the motor starts idle and if all the above conditions are O. K. then failure to start is most likely due to excessive load. To determine this definitely make or have a reliable electric shop make a test of starting torque. Wagner fractional horse power capacitor-start induction-run motors have a starting torque of 400% or more of full load torque. If the load requires more than this a larger motor is required. If this figure is 400% of full load torque and motor fails to pull in, consult the nearest Wagner Branch inasmuch as this would indicate either a misapplication of the motor, resulting in too great a load, or an increased load due to faulty driven apparatus. To Determine the Load: a. PRONY BRAKE (See Figure No. 1). This method is probably the most generally used. It requires a pulley, brake arm and scale (may be either platform scale or spring balance; if platform scale be sure that load is applied to center of platform; if spring balance is used the pull must always be at right angle to the brake arm, and in either case scale must have small enough variations to accurately read torque on smaller rated motors). Brake arm should be made up so that the distance between center of pulley and contact point where load is measured is exactly 12 inches. Scale reading will then be in pounds feet. BEFORE STARTING TEST MAKE SURE THAT DIRECTION OF ROTATION IS SUCH THAT BRAKE ARM WILL BE MOVED AGAINST BALANCE. In order to measure starting torque clamp arm to pulley tight enough to allow pulley to turn very slowly—read scale when slowly turning. To measure pull in torque release brake clamp until motor is just able to pull up to speed. The true pull in torque is the highest scale reading for which the centrifugal switch inside the motor will operate. b. ROPE AND WEIGHT (See Figure No. 2). This method gives equally satisfactory results and yet does not require the equipment of the Prony Brake method. It requires a smooth

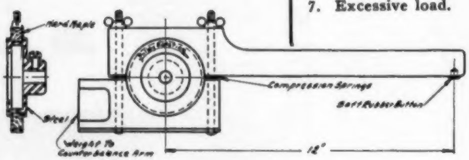


Figure 1

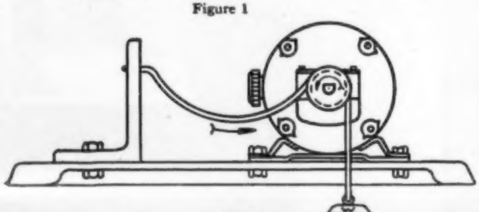


Figure 2

SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN MOTORS—Continued

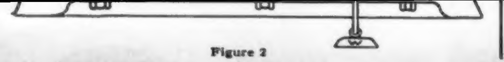


Figure 2

scale when slowly turning. To measure pull in torque release brake clamp until motor is just able to pull up to speed. The true pull in torque is the highest scale reading for which the centrifugal switch inside the motor will operate.

b. ROPE AND WEIGHT (See Figure No. 2). This method gives equally satisfactory results and yet does not require the equipment of the Prony Brake method. It requires a smooth

SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN MOTORS—Continued

PROBLEM	PROBABLE CAUSE	TEST AND REMEDY
		face flanged iron pulley, rope and weight. Tie one end of the rope to the projection from the test bench so that the rope will be at 90° to the shaft. Wrap the rope around the pulley opposite to the pulley rotation and hang a weight on the free end of the rope. Wrap sufficient turns around the pulley so that the tied end of the rope will be slack when the weight is lifted and the pulley rotates. To prevent the rope from gripping the pulley, oil or paraffin the rope slightly. Be sure that the hanging weight does not touch the floor or test bench. SOME PROTECTIVE MEASURES SHOULD BE TAKEN TO PREVENT THE WEIGHT FROM INJURING THE OPERATOR IN CASE THE ROPE GRIPS TOO TIGHT. Proceed to test as follows. Increase the weight until the motor will just start, then calculate as follows: For example, to make starting test on a ¼ HP, 1725 R.P.M. motor select a 4" pulley, ⅛" rope, and necessary weight. If assortment of graduated weights are not handy use bucket and sand (or shot), adding weight so that pulley is slowly turning. $\text{Brake Arm} = \frac{\text{Pulley Dia. in inches} + \text{rope dia. in inches}}{12 \times 2} = \frac{4+.125}{24} = .172\ \text{Ft.}$ $\text{Starting Torque in Lb. Ft.} = \text{Brake Arm} \times \text{weight hung on rope} = .172 \times \text{weight.}$ $\text{Full Load Torque in Lb. Ft.} = \frac{\text{Full Load HP} \times 5250}{\text{Full Load R.P.M.}} = \frac{.25 \times 5250}{1725} = .76\ \text{Lb. Ft.}$ $\text{Starting Torque in Percent of F. L. Torque} = \frac{\text{Starting Torque}}{\text{Full Load Torque}}$ While both of these methods are widely used by small service organizations for checking test values on electric motors of all sizes, it should be specially noted that both methods do contain an element of danger to the operator, and should be used with extreme care from the standpoint of both safety to operator and accuracy of test results.
	8. Shorted Stator.	8. See C-2 below.
(B) EXCESSIVE BEARING WEAR	1. Belt tension too great; unbalanced or out-of-line coupling; eccentric or too closely meshed gears.	1. Belts, either flat or "V", should have only sufficient tension to prevent slipping. "V" belts usually require less tension than an equivalent flat belt. Slipping of belts will cause pulleys to heat (touch), squeak (sound), or burn belts (smell). In case of unbalanced or out-of-line couplings or eccentric or too closely meshed gears—correct mechanical condition.
	2. Improper, unclean or insufficient oil.	2. The lubrication system of Wagner small motors provide for supplying the right amount of filtered oil to bearing. It is only necessary for the user to keep wool yarn saturated with a good grade of machine oil.
	3. Dirty bearings.	3. When bearings get clogged with dirt motor may need protection from excessive dust. Application may be such that especially constructed motor should be used—consult Wagner.
(C) MOTOR RUNS HOT	1. Bearing trouble.	1. See condition under B.
	2. Short circuited coils in stator.	2. Shorted coil may be located by fact that one coil feels much hotter than other. Very great increase over normal magnetic noise may also indicate shorted stator.

SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN MOTORS—Continued

PROBLEM	PROBABLE CAUSE	TEST AND REMEDY
(Don't judge motor temperature by feel of hand. Measure it with a thermometer and check with temperature rise stamped on name plate.)	3. Rotor rubbing stator.	3. Some extraneous matter may be between rotor and stator, or bearings may be badly worn.
	4. Excessive loads.	4. Be sure proper pulleys are on motor and machine. Driving the load at higher speed requires more horsepower. Take an ammeter reading. If current draw exceeds name plate amperes for full load, the answer is evident.
	5. Low voltage.	5. Measure voltage at motor terminals with line switch closed. Should not vary more than 10% from value stamped on name plate.
	6. High voltage.	6. See No. 5.
	7. Incorrect line connections to motor leads.	7. Check with connection diagram sent with motor.
(D) MOTOR BURNS OUT	1. Frozen bearings.	1. Causes may be same as under B.
	2. Some condition of prolonged excessive overload.	2. It is important that the load be examined carefully before the burned out motor is replaced so as to locate and remove the cause of the overload. Certain jobs such as refrigerators will under unusual conditions of operation, apply prolonged overloads which may destroy a motor and which may be difficult to locate unless examined carefully. On jobs where it is assumed somewhat intermittent service will normally prevail and which consequently are closely motored, the load cycle should be especially checked, as a change in this feature will easily produce excessive overload for the motor. Examine carefully to determine mechanical condition of the driven appliance.
(E) MOTOR IS NOISY	1. Unbalanced rotor.	1. When transportation handling has been so rough as to damage the heavy Wagner shipping case, it is well to test motor for unbalance conditions at once. It is even possible (though it rarely happens) that a shaft may be sprung. In any case the rotor should be rebalanced dynamically.
	2. Worn bearings.	2. If unduly frequent, examine for cause. See B.
	3. Switch rattles.	3. Install new switch hub and felt washer.
	4. Excessive end-play.	4. End-play should be reduced as near as possible to zero. In doing this be sure the bearings do not bind. ROTOR MUST TURN FREELY. Washers supplied by factory should be used in making this adjustment.
	5. Motor not properly aligned with driven machine.	5. Correct mechanical condition.
	6. Motor not firmly fastened to mounting base.	6. All Wagner small motors have steel bases so they can be firmly bolted to mounting without fear of breaking. It is, of course, not to be expected that the base should be strained out of shape in order to make up for roughness in mounting base.
	7. Loose accessories on motor.	7. Such parts as oil covers, capacitor box or cover, guards, if any, on end plate, etc., should especially be checked for security if they have been removed for investigation of any sort. The condulet box should be tightened when top is fitted after connections are made. Pulley must be tight on shaft.
	8. Air gap not uniform.	8. This results from sprung shaft or unbalanced rotor. (See No. 1 above.)
	9. Amplified motor noises.	9. When this condition is suspected, set motor on a firm floor, and if motor is quiet, the mounting is acting as an amplifier to bring about certain noises. This may occur even though mounting is quite firm in structure. Frequently correction of slight details in the mounting eliminates this but rubber-mounted type motors almost invariably do.
(F) TESTS FOR ELECTROLYTIC CONDENSERS	1. To obtain the capacity in microfarads.	1. Remove all motor leads from the condenser terminal board. Apply rated voltage at 60 cycles across terminals of condenser and measure volts and amperes. The capacity in microfarads is approximately

SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN MOTORS—Continued

SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN MOTORS—Continued

PROBLEM	PROBABLE CAUSE	TEST AND REMEDY
		Capacity = 2650 x $\frac{\text{amperes}}{\text{volts}}$ The above formula applies to a test made at 60 CYCLES ONLY. This test should be made with a fuse in series with the condenser to protect the line in case the condenser is shorted. Capacity of condenser should not be less than the rated value marked on cardboard case of condenser but may exceed it by any amount up to 40%.
	2. Test for open circuits.	2. Remove all motor leads from the condenser terminal board. Apply rated voltage at 60 cycles across terminals of condenser with an ammeter in series. If the ammeter shows no current reading the condenser is open circuited. This test should be made with a fuse in series with the condenser to protect the line in case the condenser is shorted.
	3. Test for shorts.	3. Remove all motor leads from the condenser terminal board. Apply rated voltage at 60 cycles to the condenser terminals with a fuse in series. If the fuse blows the condenser is short circuited. A 10 ampere fuse will be ample for testing a 110 volt condenser of 150 MF rating or smaller. For larger condensers use a heavier fuse.
	4. Test for grounded condenser.	4. To determine whether a condenser terminal is grounded to the metal container remove all motor leads and apply rated voltage between the terminal and the metal container with a 10 ampere fuse in series. If the fuse blows the condenser is grounded. If both terminals are grounded to the metal container these grounds will constitute a short circuit. (See "3-Test for Shorts".) If only one terminal is grounded to the case no harm will result since the container is insulated from the condenser compartment by means of a cardboard box. If voltage is applied between one of the terminals and the metal container a slight spark may occur when the circuit is broken. This is due to leakage of current through the electrolyte between the terminal and the metal container and does not indicate a ground or a defective condenser. The condenser is not grounded unless enough current flows when making this test to blow a 10 ampere fuse.
	General.	Electrolytic condensers are intended to stand intermittent applications of voltage over short intervals and will be injured if the voltage is left on too long. When making these tests the voltage should not be applied to the condenser any longer than is necessary.

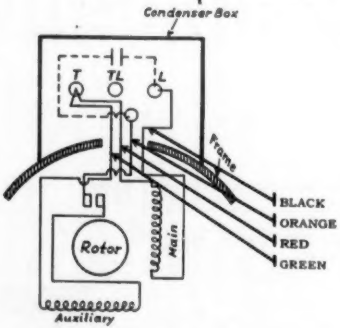


Figure 3—Connection diagram of capacitor-start induction-run motor. These connections are for counter-clockwise rotation looking at the front end (switch end) of the motor.

NEW MECHANICAL DEVICES
Service Tools and Special Equipment

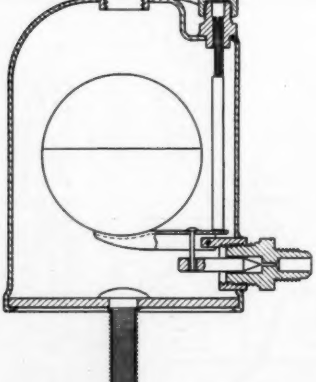
Under this heading there will be published illustrated descriptions of new or improved service tools and equipment for the Service Engineer. Information contained in this department is furnished by the manufacturer of the article described and is not to be construed as the opinion of the Editor.

The New Imperial High-Side Float

By **G. E. FRANCK***

A SIMPLE inexpensive complete high-side float has for a long time been one of the crying needs of the refrigeration dealers stock of improved service supplies. The Imperial Brass Manufacturing Company is now ready to announce to the industry a perfected high-side float, simple in operation, with moving parts reduced to a minimum and readily adapted to practically any type of refrigerant.

There are some unique and outstanding features in this device and we consider it well worth time and space to enumerate them in detail. Primarily, the new Imperial high-side float is a control for the flow of refrigerant. It is sealed and is a unit in itself, yet so constructed that the needle and seat may be removed by simple means whenever desired. This novel method of removal, the operation of which we shall describe, makes a device which can be easily serviced and avoids construction calling for bolts and flanges which are bound to cause leakage and trouble for the service man. Another feature of the design is one providing for expansion of refrigerant to take place outside of the main float chamber, thereby eliminating any distortion that might result in leakage due to temperature differences. The float can be used as an expansion valve, manually operated and adjusted so as to regulate the flow of liquefied refrigerant or it may be set to allow a continuous flow, as occasion requires.



CROSS SECTION OF NEW HI-SIDE FLOAT

A word about the construction will perhaps give a convincing picture of the advantages of this float control device. Extending downward through the purge fitting in the top of the chamber is a rod which serves the combined purpose of furnishing a purging means and a by pass or regulator for the float mechanism. The upper portion of the rod is provided with threads which are partly cut away. When the rare occasion of a gas bound condition exists due to the presence of non-condensible gases in the chamber it becomes necessary to purge the device. This is done by removing the seal cap from the purge fitting and screwing the

* Chief Inspector, Imperial Brass Mfg. Co.

HI-SIDE FLOAT UNIT

rod upward until the cut away portion becomes a small communicating passage between the chamber and the atmosphere sufficient to release undesirable gases and still hold the loss of refrigerant and its generally noxious odor to a minimum.

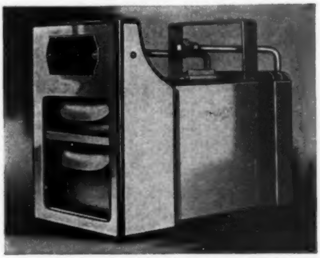
The float mechanism itself consists of a lever pivoted adjacent to the inner wall of the chamber having a float ball extended on the end. This ball is of spherical design having the highest resistance to collapsing pressures and it is of such weight that it may be used satisfactorily with either sulphur dioxide or methyl chloride and yet prevent an oil bound condition in the chamber.

A short distance from the point of pivoting, the actuating pin is extended perpendicularly from the lever and sets loosely in an opening in the needle providing an operating mechanism between the float and valve with a negligible amount of friction, insuring against "stick-up," a common ailment in the average high side float valve. The valve seat fitting which cooperates with the needle consists of one piece which may be unscrewed from the chamber to allow the manual removal of the needle from the assembly without otherwise disturbing the float mechanism whenever it becomes necessary either to inspect, replace or clean the valve.

All of the features necessary for all around effective operation have been included and unessentials have been dispensed with, resulting in the production of a small compact unit of interest to every refrigeration man.

NEW PEERLESS HUMIDI-PACK EVAPORATOR

THE tremendously diversified applications of electric refrigeration are being made simpler and easier for designing and installation engineers as a result of the Peerless principle of a complete replacement evaporator having every advantage in the one low-side.



NEW PEERLESS EVAPORATOR

Quick freezing is a major advantage as the trays are in contact with coils at both top and bottom of sleeve, and the copper tubes are hermetically bonded to top and bottom of copper tray sleeves.

Humidity is another very important advantage as heretofore the dryness of a household refrigerator had its advantages and also its disadvantages, the latter overpowering the former. The Peerless Humidi-Pack is designed to meet these problems. It has fins on the back to give that humidity that has been in such great demand. Also the fins are arranged so as to give a flue effect of fast circulation. This evaporator is of the most sanitary type of construction. By having the coils and fins so arranged as the Peerless Humidi-Pack, the housewife can wash all sides when the evaporator is defrosted.

Baffle fronts are of white vitreous porce-

lain, and are so attractive in design as to beautify any refrigerator.

The Peerless Humidi-Pack evaporator consisting of four models provides quick freezing, humidity, simplicity, and other features.

x x x

WILL DEVOTE CONSUMER CAMPAIGN TO INDUSTRY

CONSUMER advertising plans of Minneapolis-Honeywell Regulator Company, for the coming year reveal a unique plan which has for its main objective the creation of greater interest on the part of consumers, large space operators, and industry in the subject of Automatic Heating and Air Conditioning, according to George B. Benton, advertising manager of the Company.

Starting in January with page and two column copy in "Time," "Collier's," "American Home," "Nation's Business," and "Business Week," the company initiated the campaign under the general theme—"Be Modern,—Install Automatic Heating and Air Conditioning."

A quotation from a typical piece of copy reads—"Make Life Worth While—Install Automatic Heat and Air Conditioning. It's the modern thing to do for Health and downright economy, when you build or modernize. There is a competent, informed architect, engineer or dealer in automatic heat and air conditioning within reach of your phone. He has interesting information for you on what can be accomplished in your building or home."

This campaign, which will continue through January, February, March and April, will be followed immediately by a campaign selling the public on Air Conditioning under the general theme—"Air Conditioning Is Knocking at Your Door." This will stress the fact that Air Conditioning will pay big dividends in health and comfort to the home owner and reward liberally the hotel, apartment, or theatre owner in increased patronage and satisfied customers. Industry is also reminded of the fact that year-'round Air Conditioning improves plant processing and employee efficiency. This campaign will continue throughout the months of March, April, June and July in national magazines.

TRICO SERVICE MOVES

MR. A. E. KARLBERG of the Trico Compressor Service, 42 N. Paulina St., announces the removal of his firm to 440 N. Oakley Blvd. Mr. Karlberg states that this move became necessary owing to the large increase in the firm's business.

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NEW CATALOG ISSUED BY TRENTON AUTO RADIATOR WORKS

ON another page of this issue appears the announcement of the publication of the 1936 Kramer catalog, illustrating the products of the Trenton Auto Radiator Works, Trenton, N. J. This complete catalog on low side refrigeration equipment contains many unique features that will appeal particularly to the service engineer. Among these features is included the B.t.u. values and list prices of all coils at a glance, and short cuts in engineering commercial applications.

Among the subjects it discusses are: heat exchange engineering, staggered tubes, internal turbulence, solid fins, fused bond, electro-tin and all-copper plating. It contains more than 1,500 coils for walk-in coolers, three types of unit coolers, "Airlator" drip-pan coils, more than 2,700 display case coils, complete listings of small box coils, sheet coils, commercial ice cube makers, bottle cooling coils, air and water cooled condensers and domestic ice cube makers.

This catalog is available for the readers of THE REFRIGERATION SERVICE ENGINEER by using the coupon shown in their advertisement.

Branches of this company are located at 210 W. 65th St., New York City, and 5114 Liberty Ave., Pittsburgh, Pa.

x x x

NEW ALTER CATALOG AND BRANCHES

THE Harry Alter Co., Chicago wholesale refrigeration parts supply house, has issued their new 88-page catalog, which is 50% larger than the previous editions.

The catalog illustrates many new lines which have not been included in the previous issues, as well as new additions to other

lines previously shown. The catalog shows both net and list prices wherever possible.

The nationally-known manufacturers whose products are listed therein, include among others—Imperial Brass Mfg. Co.; Mercoid Tubes; Arco Copper Fittings; Henry Strainers and Dehydrators; Rotary Replacement Seals; Silver Seal Piston Rings; Penn, Cutler-Hammer, Square D and Ranco Controls; Detroit Valves and Controls; Fedders Mfg. Co. Valves and Coils; Dole-Co Cold Plates; Automatic Products; Mayson Valves; Electrimatic Valves; Chieftain High Sides; Frigerating Gas; Virginia Refrigerating Gas; United States Gauges; Prest-o-lite Gas Equipment; Practical and Tag Recorders; Black & Decker Drills; Wagner Motors; Dayton Belts.

Among the replacement parts listed are: replacement sylphon seals, needles, seats, piston pins and rings; Frigidaire, Kelvinator, King Kold, Absopure, Servel and Majestic compressor parts; receivers and condensers, copper tubing, gas masks, motors, spray equipment, lacquers, oil, refrigerating accessories, carbon brushes, starting condensers, motor bushings and about 1,000 exact replacement compressor gaskets.

The New York branch of Harry Alter Co. will be opened very shortly at 161 Grand Street, and will be in charge of Mr. George Munser. The branch has been established with a complete stock to handle all orders from the Eastern states.

In Chicago, a new south side branch has been established at 7821 Stony Island Ave., in charge of Mr. H. Spivak, to serve that particular territory. The establishment of the south side branch completes the chain of stores in each section of Chicago—the west side branch at 5217 W. Madison St. being in charge of Mr. Joe Holub, and the north side branch at 4611 N. Western Ave. in charge of Mr. H. Bernhart.

Mr. Charles Cappel, formerly manager of the refrigeration service department of the Stover Co., Frigidaire distributors, and later manager of the refrigerator department of General Household Utilities, manufacturers of Grunow refrigerators, is in charge of all Chicago sales.

Mr. B. F. Anthony is in charge of the St. Louis branch of the Alter Company.

NEW REFRIGERATOR MODELS

MOST of the refrigerator manufacturers have announced their new 1936 lines, introducing and emphasizing new exterior styling and with a number of improvements in interiors. As a whole these new models take a long step forward in bidding for increased interest and attention. The announcements of a number of manufacturers were published in the February issue. The series is continued with announcements of other manufacturers in this issue.

Williams Ice-O-Matic

The Williams Ice-O-Matic line of electric refrigerators for 1936 consists of ten models ranging in size from 4.6 cu. ft. up to 19 cu. ft. The cabinet styling is simple with a touch of the modernistic and with modified streamline effect carried out. The hinges are of the semi-concealed type and the door latch features a concealed mechanism with triple action. The door may be opened by pushing the latch right or left, or by pulling the handle forward.

The D models have an approved three-coat Dulux finish, and the P models are finished in porcelain. All interiors have a three-coat porcelain finish. The cabinet base and legs are of steel welded into a solid frame, and finished in black.

The fronts are embossed with a wide center strip flanked by two narrower strips. Tylac breaker strips are used around the food compartment door on all models. The temperature control is placed on the hinge side of the cabinet, a new and simplified control being used. The control panel has two dials, one for actuating the start and stop mechanism and the other for regulation of temperature. It offers a wide range of temperature selection, the normal setting being from 12 to 28° F., but also making available temperatures from 2 to 18° F. or as high as 38° F. The cabinet dome light is used on all models except the 4.6 cu. ft. size. Sliding drawer food systemizers are standard equipment, two with the 5 cu. ft. models and three with the 6 and 8 cu. ft. sizes. The latter sizes also are equipped with glass covered jars and each model, except the smallest size, includes a vegetable

freshener. Shelves are of round wire with wires spaced closely for greater strength and to prevent tipping, and shelves are arranged to provide maximum food storage space.

All models are insulated with balsam wool, and all steel cabinet frames are used throughout. The Ice-O-Matic Model T compressor is used in all models, the one-cylinder series in the D-3641 and 3651, and the two-cylinder series in the rest of the line. The two-cylinder compressors have pressure type lubrication to all bearing surfaces.

In addition to the standard size cabinet, three large all porcelain cabinets of 12, 15 and 19 cu. ft. net storage capacity are available. These larger models have been designed to meet the needs of larger homes and institutions.

Frigidaire

Development of a mechanical refrigeration unit that will cut electric current consumption of household refrigerators still further was disclosed recently by E. B. Newill, chief engineer and director of research for Frigidaire. The mechanism, simple in its construction and with only three major moving parts, has been termed the "Meter-miser" and will be incorporated in most of the new models to be marketed by Frigidaire this year. The unit looks much like a black derby hat and is about the same size. The motor operating it is built into it and sealed in oil. It is standard equipment except in the oversize models. It is installed in the base of the cabinet.

The Frigidaire line for 1936 will consist of sixteen models, ranging in size from 2.1 to 18.3 cu. ft. net capacity. The "Super" series, five models from 4 to 9 cu. ft. capacity with porcelain exteriors, and the "Master" series, four models from 4 to 7 cu. ft. in size with exteriors of Dulux, make up the major portion of the line. Three WP models of 12, 15 and 18 cu. ft. capacity and two special smaller sizes, 3 and 2 cu. ft. capacity, are intended to meet the needs of special markets. The Imperial and Premier are two deluxe models of 10 and 13 cu. ft. capacity designed for the luxury market.

All models will have in the center shelf a "food safety indicator" to enable the housewife to determine at any time the exact temperature of the food compartment. This indicator has three zones—freezing, safety and danger. The new models have ample ice freezing capacity, and the middle evaporator shelf lifts out to provide room for frozen dessert trays.

Greater utility has been obtained in this year's models by widening the cabinet and making it more shallow. Doors are interior of cabinet width and there is ample space for all sizes of packages, cans, containers, bottles and bulk goods. Portable utility shelves which slide out so that they can be used on the kitchen table are features of all Super models. Full width sliding shelves are standard equipment in both Super and Master models, and all models have improved hydrators. All ice trays are on shelves and a removable shelf makes it possible to make additional room for roasts and other large items. Automatic ice tray release is standard equipment. Quickube ice trays with rubber grids are standard for the Super and larger models.

The evaporator has been redesigned so that the refrigerant flows inside all walls.

The temperature control has been moved inside the cabinet at the top of the "super freezer," as has also the automatic reset defroster. Five temperatures are available —fast freezing, frozen storage, extra cold storage, moist storage and normal storage.

Fairbanks-Morse

The major changes made in developing the 1936 line of Fairbanks-Morse "Conservador" electric refrigerators include the use of a thermostatic expansion valve and a finned evaporator. The cabinet lines also have been improved and the use of the push bar latch has been incorporated. The "Conservador" continues as the outstanding feature of this line of refrigerator.

The C Series consists of four models ranging from 6.74 to 4.72 cu. ft. storage capacity. A full one-year guarantee is included with every refrigerator. The B series is the 1935 line which is being carried over into 1936 with minor changes. The sizes in this series range from 6.50 to 4.55 cu. ft. storage capacity. As with the C line, a full one-year guarantee is included with every refrigerator in this line also.

The REFRIGERATION SERVICE ENGINEER

A Monthly Illustrated Journal, Devoted to the Interests of the Engineer Servicing Refrigeration Units, Oil Burners and other Household Equipment.

Vol. 4 March, 1936 No. 3

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Official Organ
REFRIGERATION SERVICE ENGINEERS' SOCIETY

Index to Advertisements

SERVICE AS SALES OUTLET

THIS business of refrigeration servicing is a combination of many essential characteristics, which all combined make possible the building of a successful servicing business. Not the least of the many attributes which a good service engineer should possess is that of salesmanship. How many times is it necessary for a service man to resell the job after the salesman has completed his work and delivery of the unit has been made? He is called upon to keep the customer satisfied and to diplomatically rectify any extravagant promises that may have been made in the anxiety to close a sale. It is doubtful if many companies employing service engineers recognize fully the value of this department as an important adjunct to the sales department.

Service organizations operating independently have a most excellent opportunity to do a real sales job. Fortunately, many of these organizations recognize this important part of their work and you will usually find that such companies represent the successful and progressive organizations in their communities.

It is unnecessary to repeat that any service individual or organization that expects to build business in a community on a permanent basis must build it on the substantial foundation of courteous, efficient service, combined with the ability of doing good sales work, whether it be on the dependability of service or the sale of accessories.

The development of this sales activity by the service company is resulting in an important branching out of the service company as a general potential sales outlet for large manufacturers in years to come.

This is no new development, but has shown a decided increase during the past year. It is a development that is being watched because unquestionably it will represent a potential sales factor which will command the attention of those manufacturers who are constantly seeking new sources of distribution. While the business of servicing may be looked upon by some as a necessary evil, its continued progress and the number of substantial companies that are now established will deserve the attention of those manufacturers seeking new sales outlets.

REFRIGERATION SERVICE ENGINEERS' SOCIETY

Official Announcements of the activities of the National Society and Local Chapters appear in this department as well as articles pertaining to the educational work of the Society.

THE OBJECTS OF THE SOCIETY

To further the education and elevation of its members in the art and science of refrigeration engineering; with special reference to servicing and installation of domestic and small commercial equipment; for the reading and discussion of appropriate papers and lectures; the preparation and distribution among the membership of useful and practical information concerning the design, construction, operation and servicing of refrigerating machinery.

ASSOCIATION HEADQUARTERS: 433-435 North Waller Ave., CHICAGO, ILL.

Convention Dates Set

The Board of Directors of the national society have selected the dates for the 3rd annual convention in Memphis, Tenn. The three day convention will be held

WEDNESDAY, THURSDAY AND FRIDAY
NOVEMBER 11, 12 AND 13, 1936

The exhibits and meetings will be held at the Hotel Gayoso, Memphis, which has been selected as the official convention headquarters.

FROM THE ACTING-PRESIDENT

By PAUL JACOBSEN

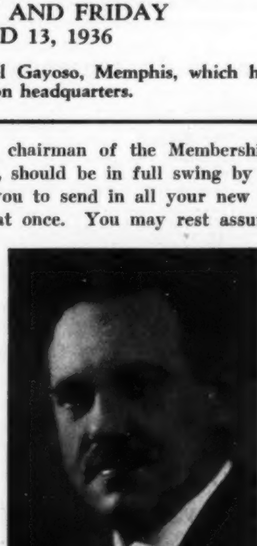
IT was a surprise to me to learn of the resignation of our National President—James H. Downs—but I am sure that I voice the sentiment of the entire membership when I congratulate Jimmy on his new position with the sales organization of Refrigeration Supplies Distributor in Cleveland and wish him success.

Also, I am sure a unanimous vote of thanks is extended to him for the excellent work he has done for our Society while he was a National officer; and the wonderful convention we attended in Detroit last October was a fine example of what can be done by a member when he possesses the right spirit.

However, he does not leave our organization just because he retires as National President. I know the Society may depend on him as one of the ablest fieldmen we have. Good luck, Jimmy!

Now, down to business:

The membership drive started by Past President Downs and Mr. J. D. Gray of St. Louis, chairman of the Membership Committee, should be in full swing by now. I urge you to send in all your new applications at once. You may rest assured that



PAUL JACOBSEN, Chicago
Acting-President

proper count will be kept of all your new members. I would suggest that in this race for the most new members, any chapter or member thereof forming a new chapter in their vicinity be given ten points credit, re-

gardless of how many members there are in this new chapter, and that this new chapter be given credit for all members signed up above the first ten so that they may be in the race also. This campaign will close on July 1, 1936, and will include all applications on which the National Society has received the per capita on the initiation fee and dues. Chapters get one point for each new member. The prize will be a mimeograph, which will be a real money-saver for the chapter in printing notices, educational bulletins and whatever printed matter may be required during the year, or $25.00 cash prize for chapter funds.

Gong! There goes the bell—They're off!

And, by the way, a question came up in the Chicago Chapter, and that was: What solution do you use when purging methyl chloride with acrolein? We will take it up with the chemical houses, and you bring this up for discussion in your local chapter.

The Committee on Symbols is working very well but asks you members to send in your suggestions for additional symbols or suggested changes in the present set-up. Let us have some action, please!

I shall appreciate hearing about your methods of securing new members. It may be valuable to other chapters.

It has been rather difficult in the past to get the members to write their suggestions, comments and criticisms to us. We judge the activities of a chapter by the number of letters we get from their officers and members. I should like to see more active interest in the National Society's affairs. It is not easy for us to determine what you want if you do not state your thoughts. Perhaps some idea of yours may bring in a number of new members, or teach us something we have never learned before; you can never tell; let us have a few words from you showing your interest in the Society. Someone made a bet with me the other day: He said I would get no replies from the members; I bet I would get at least five hundred letters, by the next convention.

A sword, a spade, and a thought should never be allowed to rust. Send in your suggestions, and bring them up at your chapter meetings for discussion. We always invite your suggestions.

Cincinnati Chapter Applies for Charter

AT a group meeting of the service men of Cincinnati held on Friday, February 14, a petition for charter for a Cincinnati chapter as a constituent organization of the National Society was drawn up. Through the courtesy of Mr. Al Chadburn, Jr., of Williams and Co., Inc., arrangements for the meeting were provided at the new home of Williams and Co., at Henry and Dunlap Streets, Cincinnati. The National Society was represented by Mr. Claude A. Brunton, national sergeant-at-arms, of Huntington, W. Va., who called the meeting to order. Mr. Chadburn was selected as Temporary Chairman, with Mr. H. S. Klugman, also of Williams and Co., as Temporary Secretary.

The meeting was then addressed by Mr. Brunton, who set forth the educational benefits to be derived from a local organization affiliated with the National body.

Following the address of Mr. Brunton, a resolution was introduced and passed to the effect that it was "the consensus of opinion of those present that it would be desirable to organize a cooperative society for the purpose of furthering the education and elevation of the men engaged in the business of installing and servicing domestic and commercial refrigerating equipment and that plans be immediately made to form and organize a local chapter of the R.S.E.S."

At this point a rising vote of thanks was extended to Williams and Co. for providing the meeting headquarters and also to Mr. Chadburn and Mr. Klugman for their help and assistance in the success of the meeting. The next order of business was the election of officers for the formative period of the local organization, and the following were selected: President, W. D. Salyers; First Vice-President, R. J. Weller; Second Vice-President, R. B. Howard; Secretary, D. A. Perry; Treasurer, Mr. Schill; Sergeant-at-Arms, H. M. Lester.

CLAUDE A. BRUNTON, Huntington, W. Va.

The meeting was then turned over to the newly elected officers, and the necessary number of formal applications having been received and the charter list signed, this was immediately forwarded to the National Headquarters by Mr. Brunton for their action.

The National Organization welcomes this newest chapter to its rolls and seeks its active participation in the furtherance of the advancement of those men engaged in refrigeration servicing.

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CLEVELAND CHAPTER

Meeting of January 14, 1936

By K. P. WALL, *Secretary*
3348 St. Clair Ave., Cleveland, Ohio

AT the meeting of Cleveland Chapter of January 14, the principal activity to be considered was the election of officers, and the following officers were selected for 1936: President, George J. Schuld; 1st Vice-president, Ed. Vadakin; 2nd Vice-president, Otto Sippel; Secretary, K. P. Wall; Treasurer, W. W. Farr; Sergeant-at-arms, A. E. Finke; Board of Directors: F. N. Schuld, Claude Husted, Lawrence Gardella.

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1936 DUES NOW PAYABLE

To avoid interruption in the receipt of your Lecture Course and Official Organ, pay your dues promptly.

Finance Committee of Memphis Chapter Starts Work for 3rd Annual Convention

By W. H. McDOWELL, *Chairman*
Memphis Convention Finance Committee

ONE of the important functions of the local convention committees is that delegated to the Finance Committee in providing for the necessary funds for the holding of the convention. We believe that our local president, George L. Uetz, stated the case correctly when he stated, "only by careful planning and proper execution of our plans may we expect to have the kind of a convention we desire."

I know the members of our National Organization will be interested to learn that the Convention Finance Committee has taken up its work in a serious way. The first step to be decided is how much money is necessary. The Finance Committee met with the Entertainment Committee and asked for their estimate of the amount needed for entertainment during the three days of the convention. After receiving their report, this committee increased the amount required per day by 25 per cent, with the following budgets established as follows: November 11, \$475.00; November 12, \$1,075.00; November 13, \$600.00.

The next important step is to determine the source of the revenue. Analyzing the report of the Second National Convention, it was agreed that we could expect, with the increase the National Society is showing, a minimum of no less than five hundred guests, and with the efforts of the members concentrated on their labor so early in the year we have every reason to believe we should prepare for possibly twice this number of delegates and guests.

I wish to assure you that the plans for securing this money have been completed,

MEMPHIS CHAPTER CONVENTION FINANCE COMMITTEE

W. S. Weidlein — Jack Brothers — W. H. McDowell

and remains only to be distributed at the proper time. This, of course, is the work of the Entertainment Committee of whose activities you will hear more in the near future.

There will be a nominal registration fee for delegates and their friends of $2.00 as at the last convention.

Now for some practical examples of your actual convention costs. A man and wife, or two men, living 1,000 miles from Memphis, can attend by driving their car at an approximate total expense of $60.00 in the following manner:

1—Early hotel reservations may be secured from $2.00 to $4.00 per day. Leaving home early on Tuesday morning and arriving Tuesday night, with hotel accommodations, including Tuesday and Friday nights' lodging $16.00
2—Registration fee 4.00
3—Meals (less those provided by local chapter and amount ordinarily spent at home) 10.00
4—Automobile expense (gas and oil). 26.00

A total of $28.00 each. $56.00

Under similar circumstances, for two couples, or four members, sharing the same accommodations the following would be the approximate cost:

1—Early reservations $28.00
2—Registration fee 8.00
3—Meals 20.00
4—Automobile expense 26.00

$82.00

Or $41.00 per couple, or $20.50 each.

Naturally, if you are within a closer radius than 1,000 miles of Memphis, your expenses will be proportionately lower.

Our entire plans are being made to give every consideration to the visitors, and we have concentrated our efforts toward a bigger and finer convention at less cost to the delegates and their friends.

There will be absolutely no charge for any type of entertainment, which will all be covered by the registration fee during the entire three days of the convention, and I am sure that when the Entertainment Committee makes its report you will agree that the only thing necessary to make this the out-

standing convention we anticipate it will be is *your personal attendance.* Approximately thirty weeks remain before the convention. Now is the time to make plans to set aside a definite amount each week toward your convention expenses. Finally,—mark the calendar for November 11, 12 and 13, and partake of real "Southern Hospitality."

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PITTSBURGH CHAPTER

Meeting of February 10, 1936

By F. V. GOLITZ, *Secretary*
1518 Davis Ave., Pittsburgh, Pa.

THE regular meeting of Pittsburgh Chapter was held in the Corporation Room of the Commonwealth Building, President C. O. McCauley presiding.

The presiding officer introduced Mr. C. P. Rittling of the Fedders Manufacturing Company of Buffalo, who gave a lecture illustrated with slides on the Fedders refrigeration equipment. The lecture proved interesting and instructive to assembled members and visitors. In behalf of the officers and members, Mr. McCauley thanked Mr. Rittling.

The minutes of the previous meeting were read by the Secretary and accepted as read. This was followed by a discussion on membership and dues. Correspondence was then read by Mr. McCauley.

President McCauley introduced Mr. W. Augustine of the Brown Dorrance Co., distributors for Grunow, who promised to return for the April meeting and lecture on Grunow refrigeration. Next, Mr. Armbruster of the Oakland Refrigeration Supply Co. was introduced.

The election of officers was held, which resulted in the re-election of all the present officers, who are: President, C. O. McCauley; Vice-president E. Vernon Black; Secretary, F. V. Golitz; Treasurer, John Kane; Board of Directors: H. S. McCloud, Wesley Barnes and John Kirch, Jr.

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YOUNGSTOWN CHAPTER

Meeting of January 6, 1936

By ROY KEITH, *Secretary*
94 E. Chalmers Ave., Youngstown, Ohio

THE January 6th meeting of Youngstown Chapter was held as a dinner meeting in

the Central Y.M.C.A. A delicious dinner was served to the members.

After the dinner, President Eich introduced Mr. Merkle of the Automatic Reclosing Circuit Breaker Company, the principal speaker of the evening. Mr. Merkle gave a very interesting and informative talk on the products of his company. He also passed out service manuals to the service men present.

Following Mr. Merkle's departure, the regular meeting was called to order by President Eich, and roll call of members followed.

The report of the Secretary was accepted as read. The Treasurer's report was read and accepted.

Questionnaires were passed out the members who had not received any previously.

Mr. J. King reported that according to an amendment to the sales tax law, no tax is to be collected on materials sold to stores selling meats, groceries, etc.

Announcement was made that the election of officers will take place at our January 20th meeting.

Motion made by Mr. King to appoint a Nominating Committee consisting of Messrs. Bokesch, Sr., M. W. Remaley and Roy Keith, was accepted.

Martin Bokesch, Jr., moved that the chapter give Mr. King $10.00 to help cover the cost of light, heat, etc., for the use of his offices and storerooms as a meeting place.

Mr. Ed Wright gave a talk on refrigeration codes and licensing provisions in other cities. Mr. Wright also moved to appoint a committee to further investigate the possibilities of a code in Youngstown. The Code Committee consists of Messrs. Wright, Bokesch and Kreitzburg.

Meeting of January 20, 1936

The meeting was called to order by President Eich. Roll call of officers and members followed. The Secretary's report was accepted as read, as was the Treasurer's report.

The Nominating Committee then recommended that election of officers be held. Mr. Charles P. Eich, our president for 1935, withdrew from the list because of working conditions where he is employed. Election of officers then followed, which resulted in

the election of Roy Keith as president; Homer Butler as vice-president; Martin Bokesch, Jr., secretary; Martin Bokesch, Sr., Treasurer; Reese Davies, sergeant-at-arms; members of the Board of Directors: Messrs. Dallas Nutt, M. Remaley and E. Wright.

At this point President Eich relinquished the chair to Mr. Roy Keith.

Mr. Wright presented another talk on refrigeration codes, reading extracts from the New York code and a letter from *Refrigeration News*. He also answered questions of members and cleared up doubtful points of the code.

Mr. J. King was retained as Educational Director for the coming year.

Mr. Bokesch brought up the subject of dues for 1936 and urged that the members make prompt payment.

Mr. King outlined the educational program for 1936.

Meeting of February 3, 1936

By MARTIN BOKESCH, JR., *Secretary*
R. F. D. No. 5, Youngstown, Ohio

President Keith called the meeting to order. The minutes of the last meeting were read, with one correction, and the Treasurer's report was accepted as read.

Mr. Bokesch suggested setting a deadline for payment of all dues, both monthly and yearly, and also read the standing of the members in regard to dues.

Announcement was made that the Board of Directors will meet Monday, February 10th, at the home of President Keith at 94 E. Chalmers Ave.

Mr. Ed Wright gave a continuation of his talk on the code and licensing business, reporting on accomplishments thus far obtained. Members held a discussion of the details of the New York code to determine whether it would fill the requirements of Youngstown Chapter. The following changes were recommended: License Fees, $50.00; Bond, $1,000.00.

Mr. Eich moved that the Code Committee proceed with plans to have all legitimate contractors attend a meeting to discuss further plans in connection with the code, the time and place to be decided by the committee.

Meeting of February 17, 1936

President Keith called the meeting to order, which was followed by roll call of mem-

bers. Minutes of the last meeting were then read and accepted as read, as was the Treasurer's report. Report of the Board of Directors meeting was heard and several points decided upon.

Mr. King moved to accept recommendation to make test on equipment, members to be appointed for each test to set up apparatus.

Mr. Wright moved that the Question Box idea be adopted, which was seconded by Mr. Eich and which motion carried. Mr. King suggested that questions be assigned to each member to be discussed individually, one or two questions at each meeting.

Mr. Eich made a motion to purchase a master service manual and an engineers' handbook to be kept in a central location for reference by members.

Mr. Eich moved that the deadline for payment of dues be set at March 2, and that all members be notified of this action by mail. If members take no action by March 2 they will automatically be suspended. If no action is taken by March 16, the members will be automatically dropped from the roll. All members shall be asked to state their intentions of remaining with or dropping from the Society.

Mr. Wright suggested that this letter to the members also contain information about educational program for the coming year, information about licensing proposition and outlining progress of past year, which was approved by those present.

Mr. Keith was appointed to talk on high side floats at our meeting of March 2.

Mr. Wright moved that petition be drawn up for license, to be submitted for approval to members of the society and to refrigeration contractors,—petition to follow lines of Detroit licensing petition. This motion was duly carried.

Mr. Remaley was appointed to talk on Temprite coolers at March 16th meeting.

President Keith appointed a grievance committee, with provision that in the event of any member of said committee becoming involved in any grievance, the President shall take said member's place. Committee consists of Messrs. J. King, C. Eich and M. Remaley. He also appointed a credit list

committee consisting of Mr. Bokesch, Sr., G. Kreitzburg and R. Davies.

Members resolved that the following prices be considered standard: Sulphur dioxide 50c per lb.; methyl chloride $1.50 per lb. up to ten lbs.; Isobutane $2.50 per lb.; Freon $1.75 per lb.; thermostatic expansion valve, list $15.00, in exchange $11.50 plus labor; low side float valve, replacement $9.00 plus labor; automatic expansion valve, installed $10.50; labor $1.50 per hour; mileage 5c per mile.

MEMPHIS CHAPTER

Meeting of February 10, 1936

By **R. F. WEIDLEIN,** ***Secretary-Treasurer***
765 Ellsworth, Memphis, Tenn.

REPORTS of the committees were called for, but the Finance Committee was the only one ready to report. President Uetz asked to meet with the Finance Committee at his home on Sunday, February 16, at 10:30 A. M. The Secretary was requested to attend this meeting. Mr. Elliot was introduced as a visitor.

The Entertainment Committee was requested to meet with President Uetz at his offices in the Memphis Power and Light Company Building at 3:00 P. M. on Tuesday, February 18th. It was also announced that the ladies would be asked to attend a meeting to be held Tuesday evening, February 18, 7:30 P. M. at the Gayoso Hotel on the mezzanine floor.

Unfinished business: President Uetz proceeded to read the various proposals submitted in connection with the National convention to be held in Memphis next Fall. The first proposal was submitted by Poland, the Photographer. Motion was made by Mr. McDowell and duly seconded by Mr. Hunt that the proposal be accepted subject to the confirmation of the National Board of Directors. Motion carried.

The proposals of the Peabody Hotel and the Hotel Gayoso were carefully read and discussed, and motion was immediately made by Mr. Sparks and seconded by Mr. McDowell that the Hotel Gayoso proposal be accepted, subject to approval by the Na-

tional Board of Directors. Motion carried.

President Uetz read a proposed letter to Mr. McDermott and one to be sent to the different chapters. He then gave a sketch of expected expenses and receipts.

Communications were read from the National Secretary and his office.

The Educational Committee then took command of the floor, and a very interesting discussion of the lecture took place.

Meeting of February 17, 1936

The Finance Committee report was read and upon motion by W. C. Easley, which was seconded by A. R. Black, it was approved. They announced that $700 would have to be raised by the local finance committee. This committee was also asked to meet with Poland, the Photographer, and have pictures made, same to be sent to the National Society for publication in our Official Organ.

The potential membership list submitted by the Membership Committee was thoroughly studied and gone over by the entire chapter.

The Entertainment Committee was reminded to meet with the ladies at the Hotel Gayoso on Tuesday evening.

The Auditing Committee gave a report which was read to the chapter and approved at once.

The Visiting Committee reported the following members ill and unable to attend the meeting; Ed Hunt, R. J. Rick and George Dotson.

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CHICAGO CHAPTER

Meeting of February 11, 1936

By H. D. BUSBY, ***Secretary***
5611 Lawrence Ave., Chicago

THE meeting was called to order at 8 P. M. by Mr. R. L. Hendrickson, who opened it with a short outline of future educational matter and his intentions as regards the Lecture Course issued by the National Society. It was decided the best approach to the Course was through the reading of the individual bulletins by Mr. Hendrickson and then a discussion to follow. Mr. Hendrickson devoted a half-hour to this reading and discussion.

After a ten-minute recess, the regular meeting was called to order with the roll call of officers revealing the following present:

Messrs. Jacobsen, Skipple, Armstrong, Roth, Busby and Hendrickson.

President Jacobsen then introduced Mr. Walthers of Great Falls, Montana, of the General Service Company, who was a visitor for the evening. Mr. Walthers gave a short talk on service conditions and business conditions in general in Montana.

For the benefit of the visitors present, Mr. Jacobsen gave a résumé of the objects of the Society and the benefits to be derived therefrom when becoming a member.

The meeting was then turned over to Mr. Hendrickson, who gave a talk on the conversion of the Servel old high side float system to a modern type of system.

Considerable discussion arose as to the possibility of securing a neutralizing agent for tear gas when purging. Mr. Herman Goldberg volunteered to look into the matter and to write to the Ansul Chemical Company laboratories for any information they may have.

Mr. Goldberg, reporting for the Entertainment Committee, announced the annual banquet to be held approximately six weeks from date. His entertainment program for the year further promises a stag sometime before the summer weather sets in, and a picnic sometime during the summer.

KANSAS CITY CHAPTER

Meeting of February 11, 1936

By* R. E. KINGSOLVER, *Secretary
2212 East 38th St., Kansas City, Mo.

REPORTS were submitted by the Educational, Entertainment, Membership, and Committee on Standards.

The administration of the oath was given to the following new members: Messrs. Max Weiss, Otis Clark, C. L. Hataway, V. G. Phillips.

The nine applications for membership submitted by the Membership Committee were voted upon and approved by the chapter.

It was agreed that the member bringing in the most applications for membership by the next regular meeting would receive his R.S.E.S. lapel button as a reward.

President Roy Cox introduced Mr. Applebee of the Burstine-Applebee Company and Mr. Shomaker of the Frigidaire Corporation.